

**Engineers Australia
Engineering Heritage Victoria**

**Nomination for Engineering Heritage Recognition
under the
Engineering Heritage Australia Heritage Recognition Program
for the**

**BLACK POWDER MILL
Cairnlea, Victoria**



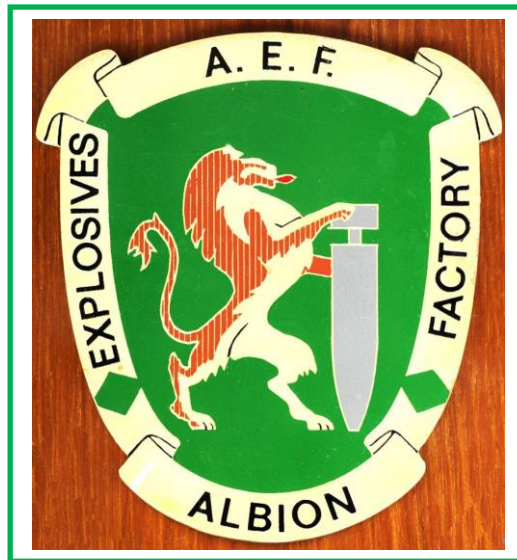
June 2016



Front Cover Photo

Image shows Restored Black Powder Mill House, Building 745, used for the manufacture of Black Powder at the former Albion Explosives Factory, Deer Park Victoria on an Open Day, 2005.

Photograph Courtesy the late Mr David Meale, 2005.



**Friends of the Black Powder Mill Incorporated kindly acknowledges
the support of the Brimbank City Council**

Table of Contents

1.0	Introduction	4
2.0	Heritage Nomination Letter	5
3.0	Heritage Assessment	6
3.1	Basic Data	6
3.2	Modifications and Dates	7
3.3	Historical Notes	8
3.3.1	Background	8
3.3.2	Australian Explosives and Munitions Heritage	10
3.3.3	Deer Park	11
3.3.4	Albion Explosives Factory	15
3.3.5	The Black Powder Mill – A Chronology	16
3.4	Heritage listings	18
3.4.1	Heritage Victoria	18
3.4.2	The National Estate	18
3.4.3	City of Brimbank	19
4.0	Assessment of Significance	19
4.1	Historical Significance	19
4.2	Historic Individuals or Association	20
4.3	Creative or Technical Achievement	21
4.4	Research Potential	21
4.5	Social	22
4.6	Rarity	22
4.7	Representativeness	23
4.8	Integrity/Intactness	23
5.0	Statement of Significance	23
6.0	Area of significance	26
7.0	Interpretation Plan	27
7.1	General Approach	27
7.2	General Attributes of Interpretation Panel	27
7.3	The Interpretation Panel	28
7.4	Possible Themes for Interpretation Panel	28
7.5	Preliminary Text Boxes for Interpretation Panel	29
7.5.1	Proposed Text	29
7.5.2	Suggested Illustrations	30
8.0	References	30
Appendix 1.	Maps, Plans and Drawings	31
Appendix 2.	Photographs	37
Appendix 3.	Black Powder	42
Appendix 4.	Drawings of Interpretation Panel and Mounting Stand	45
Appendix 5.	Edge Runner Mills	47
Appendix 6.	Acknowledgements	49
Appendix 7.	Letters of Approval and Support.	52

1.0 Introduction

The Black Powder Mill represents a significant engineering achievement in the design of an explosives manufacturing process, incorporating a purpose built structure housing dedicated plant and machinery, developed over the course of many centuries for the safe production of a material which is inherently dangerous to handle.

It was built in 1942 at a time when Australia faced great danger, fearing a Japanese invasion from the north as part of a much wider increase in the scope and diversity of Australia's Munitions industry. The technology was not new and the design followed basic principles which had been developed over a long period of time and are clearly illustrated in this building.

It was required to supplement the output from an existing Black Powder Facility, then operating at the ICIANZ plant also situated at Deer Park which had manufactured black powder for civilian and military use since 1935.

It is now the only explosives processing building open to the public where these engineering design principles can be seen, explained and appreciated. It is the only surviving building of the approximately 400 which made up the Albion Explosives Factory, which closed in 1986.

Following the cessation of explosives manufacture at the Orica Limited site and its consequent re-development, it is now also the only remaining explosives process building in Deer Park designed by ICIANZ. This site has a history of explosives manufacture which extends back over 100 years to 1876.

The Black Powder Mill has been nominated for recognition under Engineering Heritage for the following reasons:

1. The Black Powder Mill is of historical and technological significance to the state of Victoria and, in the wider context, to Australia.
2. It is a link between the production of modern munitions and explosives for defence and civilian purposes from a time when black powder was mixed by hand in rudimentary equipment on the gold fields in the 1860s using technology which could have been nearly 1000 years old.
3. The building and plant demonstrate the major design principle of '*separation of the stages*' in the manufacture of explosives so that an incident in one would not propagate to the next, thereby limiting the extent of the damage. This feature is evidenced by the large areas required for an explosives facility. The Albion Explosives Factory occupied approximately 500 hectare.
4. The explosives processing bay is completely contained and designed to minimise the collection or build up foreign material which could sensitise the black powder.
5. All electrical items, lights switches, starters and drive motors are either outside the bay or in a separate motor room.
6. The siting of the building and plant within the factory perimeter is remote from other operations, reflecting the nature of the process.
7. The siting of the Factory in an undeveloped locality but within reach of other related facilities for support and services is also an important safety consideration.
8. Being the only munitions manufacturing building remaining in the western suburbs of Melbourne, it has been acknowledged as a tribute to the approximately 25,000 people who worked in that locality in the Munitions industry during World War 2, as well as those from the periods before and after the war years.
9. It also recognises the contribution of the many un-named technical and administrative personnel who developed, adapted and designed these plants and buildings, and supervised the processes to ensure the safety of all who worked in the Facility and of those who lived in the immediate neighbourhood.

2.0 Heritage Award Nomination Letter

The Administrator
Engineering Heritage Australia
Engineers Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Name of work: Black Powder Mill

The above-mentioned work is nominated for an award under the Engineering Heritage Recognition Program.

Location, including address and map grid reference if a fixed work: The corner of Parklea Drive and Grassy Point Road, Cairnlea, Victoria, Vic, 3023. Melway Reference Map 25 F6.

Owner :

City of Brimbank.
Brimbank City Council,
Sunshine Office,
6-18 Alexandra Avenue,
Sunshine, Vic, 3020.
PO Box 70, Sunshine, VIC. 3020.

The owner has been advised of this nomination and a letter of agreement is at Appendix 7.

Access to site: By road to the above location.

Nominating Body: Engineering Heritage Victoria

David LeLievre
Chair, Engineering Heritage Victoria

Date: To be inserted

3.0 Heritage Assessment

3.1 Basic Data

Item Name: Black Powder Mill, Building 745, Fuze Powder Section, Albion Explosives Factory.

Other/Former Names: Gunpowder Mill House, Building Z.9., Explosives Annexe No 5, Deer Park.

Location: Corner of Parklea Avenue and Grassy Point Drive, Cairnlea, Vic, 3023.

Address: Corner of Parklea Avenue and Grassy Point Drive, Cairnlea, Vic, 3023.

Suburb/Nearest Town: Cairnlea.

State: Victoria.

Local Govt. Area: City of Brimbank.

Owner: City of Brimbank, 6-18 Alexandra Avenue, Sunshine, Vic, 3020.

Current Use: Open to the public on a regular basis as advertised, at least twice each year, and on special request. The production of black powder is explained and the mill is operated.

Former Use: Milling of ingredients as the primary stage in the production of black powder for use in artillery and bomb time-ring fuzes.

Designer: Engineers employed by and/or under contract to ICIANZ or possibly by ICI Ltd of UK.

Maker/Builder: Not known.

In all probability, its construction would have followed a similar path to that employed on many of the later projects for the construction of explosives processing buildings. In conjunction with the design of the Mill, the building would be designed by civil engineers and architects, and a construction contractor engaged. While this was proceeding, the plant and machinery would have been designed by process and mechanical engineers and similarly contracted out. When both phases were completed the machinery would have been installed and commissioned. Because of the war time situation the stages would have been compressed and overlapped as far as possible but were most likely to be as follows:-

- Design of the Mill including all mechanical components to the specification of the process engineers to meet production and safety requirements.
- Design of the Mill building to accommodate the plant and machinery.
- Construction of the Mill building.
- Fabrication of the Mill and drive system, if not already available.
- Installation of the plant and machinery.
- Acceptance of the construction of the building and the installation of the plant ensuring that these complied with the specified design requirements
- Commissioning and testing of the Mill and associated plant and equipment.
- Inspection by authorised professional process supervisors for clearance ensuring that the building and plant were clean and fit to be used for the production of Fuze Powders.

Unfortunately those personnel involved in these steps are not known but they would have been overseen by professional staff of ICIANZ. Their identification could be the subject of further research.

A key component of the drive train for the Mill is a worm reduction gear. The maker's plate indicates that it was made locally by Richardson Gears Pty Ltd, a notable engineering firm founded in Footscray in 1913. It was made under licence from David Brown & Sons (Hudd) Ltd, presumably of Huddersfield, England.

Year Started: c1942.

Year Completed: 1942.

Physical Description: The Mill house consists primarily of a heavy concrete wall built in the shape of a broad V which encloses the mill on two sides and provides a protecting screen to other parts of the factory. The other enclosing walls, being designed to afford pressure relief in the event of an explosion, are lightly constructed of 'masonite' sheets on a timber frame, a section being 'glazed' with cellulose acetate for lighting the mill house. The roof is of light construction, consisting of timber, covered externally with 'malthoid' (bitumastic felt). The floor is covered with 'malthoid' sheets cemented down.

The Mill is of the underdriven suspended edge runner type, the runner tyres and pan being made of an iron alloy and the ploughs of a non-ferrous metal with phosphor-bronze wearing strips. The mill is supported by a heavily reinforced concrete floor beneath which is the motor room, housing the electric motors and driving gear. The start and stopping switches were originally installed on the outside of one of the concrete walls but have now been relocated in the motor room for additional protection.¹

Physical Condition: The Mill and the building have been refurbished between 2002 and 2005 and are now maintained in good condition by City of Brimbank staff.

(Refer to Appendix 2 for images of the building and plant)

3.2 Modifications and Dates

The Black Powder Mill operated for only a short time from 1942 to 1944 to satisfy a wartime requirement and no plant improvements were considered.

During the restoration, it was not possible to locate electric motors of the same frame size as the originals. It was necessary to utilize two motors from roughly the 1950s and modify the slides of the bases accordingly.

The control switches for the motors were originally mounted on the western concrete wall outside the process bay but are now located in the motor room for additional protection. An emergency stop button has been provided near the access door to the Mill bay.

¹ This description has been adapted from that given in the *Report on the Circumstances attending an Explosion which Occurred in the Gunpowder Mill House Z.9.,Fuze Powder Section, Explosives Factory, Albion on 18 May 1944*, prepared by E. C. Todner, Executive Member, Operational Safety Committee.

3.3 Historical Notes:

3.3.1 Background

Notes initially adapted from National Trust of Australia (Victoria), Classification Report for Black Powder Mill, July 2001, incorporating several corrections and amendments based on additional research.²

In general, few explosives manufacturing facilities were built in Australia. The earliest were black powder works serving mining and fire arms. In the nineteenth century, these were basic operations with little investment and were spread at various locations, near the capital cities or the goldfields. The major use of the product was for rock blasting and many of the small ventures included '*Blasting*' and '*Safety*' in their titles.

Explosives became more important to Australia from the time when gold mining turned from alluvial mining to hard rock mining in the 1860s and 1870s. The majority of the early supply of black powder came from imports while it may even be possible that some may have arisen from hand mixing of the ingredients in unsafe conditions in primitive equipment on the gold fields themselves. The history of this period has concentrated on business aspects, such as the need for formation of (usually limited liability) companies which could amass sufficient capital to survive through the digging phase until they reached the gold. Additionally, explosives were important in other spheres of development, notably their use in infrastructure development such as road and railway construction (cuttings and tunnels) and in dam building.³

Wixted has identified the earliest attempts to manufacture black powder locally in Victoria from the mid-1860s from several references. Factories were established at various locations, Footscray, the south bank of the Yarra, Yarraville, Brunswick, Collingwood, and in the regional mining towns including Bendigo, Stawell, Ballarat and Eaglehawk.⁴

The Report of the Victorian Inspectors of Explosives, 1879 refers to 'Safety Blasting Powder' works in Yarraville, Dights Falls (ie Collingwood) and Sandhurst (ie Bendigo).⁵ A report in *The Age* in May 1879 refers to two companies in Collingwood, the Eclipse Safety Mining Powder Company and the Safety Blasting Powder Company.⁶ This latter company was operated by C Lyons in Dight's disused flour mill at Dight's Falls in Collingwood in 1876.⁷ The flour mill had utilised an undershot waterwheel for power and it could be that the same was used to drive a mill for the production of blasting powder. Further research would be necessary to confirm this.⁸

² See also Wixted D., *Black Powder Mill, Grassy Point Road, Cairnlea, Conservation Plan*, Prepared for City of Brimbank, Heritage Alliance, September 2003, Section 2.0, page 5.

³ In the original document this paragraph is referenced as being personal correspondence to the authors from Professor Ian Rae, presumably in 2001.

⁴ Wixted, D., *ibid*, pages 25ff.

⁵ Victorian Parliamentary Papers, VPARL1880-81 No 18, Public Record Office, Victoria. This can be downloaded from <http://www.parliament.vic.gov.au/vufind/Record/74559/Details>, accessed June 2016. This may be the first such Report by the Inspectors of Explosives under the Explosives Act 1877. Earlier reports are not available on that web site.

⁶ *The Age*, 29 May 1879, page 3, column 5.

⁷ Milner, P., *Living Dangerously: Gunpowder and other explosives in Victoria Australia, in the Nineteenth Century*, Chap 19, page 320 in Buchanan, B., (Ed) *Gunpowder: The History of an International Technology*, Bath University Press, 1996.

⁸ Dight's Mill Collingwood is listed on the Victorian Heritage Data Base, HI D7822-0042, HO48.

In Bendigo in May 1882, three manufacturing companies, the Bendigo Safety Blasting Powder Company, the Excelsior Safety Blasting Powder Company and the Champion Powder Works met and agreed that due *'to the high price of material, the Price of Safety Powder will be: Fine 4½d; Granulated 5d'*.⁹ Was this price-fixing? A licence for the manufacture of *'ordinary blasting powder'* at Black Hills, Ballarat was granted in 1883.¹⁰

The Inspectors' Report for 1879 provides the clue that these were low technology operations with the comment: *'These manufacturers have not attempted to make any ordinary gun or blasting powder, - nor to introduce any machinery - all the work is done by hand.'*

The Australasian Powder and Explosives Manufacturing Company founded by von Bieren in the Sydney suburb of Narrabeen operated for just a few years in the mid-1880s.¹¹ The establishment of this enterprise seems to have been an elaborate fraudulent scheme, as, while a number of substantial structures were built, there is no mention of a mill and no report of any production. It may have been sanctioned by the then German government. Von Bieren left the colony pursued by the law.

A replica gunpowder mill at Penny Royal, Launceston, Tasmania was a re-creation in timber of a nineteenth century water powered gunpowder mill as part of a tourist theme park. It was built in the 1970s but has been closed now for around 12 years.¹²

It seems reasonably certain that the early production of black powder in the Australian colonies was directed toward the mining and construction industries in small localised factories from which the end user could readily obtain their requirements. These would have complemented the quite substantial import trade. In these situations, black powder had two main uses. One was as a fuze when burned in a relatively unconfined state, the other for blasting when solidly tamped into shot holes, in which case it was fired from a distance using safety fuze and detonator or cap.

The Fuze factory of Perry & Hunter (later Bickford Smith) in Bendigo survived into the twentieth century operating until 1913. The building still exists and is listed on the Victorian Heritage Database.¹³ A plan of the factory on this website seems to show a large workshop but in the discussion, there is no mention of the manufacture of black powder, only outlining the process for the manufacture of safety fuze. The opening of their 'new' fuze factory is described in some detail in the Supplement to the *Bendigo Advertiser* in May 1876.¹⁴ Here also the description of the process only mentions the innovations employed in the manufacture of safety fuzes. It is therefore probable that the black powder used in the fuzes was supplied by others, either from imports or manufactured elsewhere.

Black powder was the major explosive for civil and military purpose until the mid-nineteenth century. Two important discoveries were made at that time.

⁹ *Bendigo Advertiser*, 6 May 1882, page 3, column 6.

¹⁰ Annual Report, 1883, Inspectors of Explosives, VPARL1885, No 61, page 1.

¹¹ Ingleside Powder Mill Threads collected and Collated by A J Guesdon, Copyright Pittwater Online News, 2012. See <http://www.pittwateronlinenews.com/ingleside-powder-works-history.php>, accessed 1 June 2016. This is now believed to have been a German Government scheme to obtain technical information through a fraudulent scam. See also Linge, G J R, *Industrial Awakening: A Geography of Australian Manufacturing, 1788-1890*, Australian University Press, Canberra, 1979, page 480.

¹² *The Examiner*, Launceston, Tasmania, 16 March 2013 at <http://www.examiner.com.au/story/1368426/penny-royal-revival-hopes/>, accessed June 2016.

¹³ Victorian Heritage Database VHD No H 1680.

¹⁴ *Supplement to The Bendigo Advertiser*, 1 May 1876, page 1, column 1.

Firstly, *Guncotton* was discovered in 1846. It is '*cellulose nitrate or nitro-cellulose*' and was prepared by the reaction of mixed nitric and sulphuric acids on cotton followed by washing with copious quantities of water. It looks like the cotton from which it was made and burns rapidly. If confined, it can burn to detonation. It was more powerful than black powder, which was generally in use at the time, particularly so where the rock was very hard. It was demonstrated in Cornwall in late 1846 where, after being placed in the shot hole, it was detonated by a safety fuze of black powder. Several accidents occurred during manufacture but by the 1870s, the process had been refined and mixtures of guncotton and either potassium or sodium nitrate, called '*nitrated guncotton*', were being used.¹⁵

An early guncotton works, operated by Mark Gardener, was established in the Cranwell St, Braybrook area, near the Maribyrnong River in 1873-1876.¹⁶

The second discovery was the 'taming' of nitro-glycerine by Alfred Nobel in the period 1864 – 1870.¹⁷ This involved the adsorption of nitro-glycerine in diatomaceous earth thereby rendering it less sensitive.¹⁸ The product was named '*dynamite*' and became the major blasting explosive. This development is discussed in the following sub-section.

3.3.2 Australian Explosives and Munitions Heritage

The wider heritage of the explosives and munitions industry is increasingly under threat in Australia.

A modern black powder plant was operated by ICIANZ at Deer Park from 1935 to 1970. This had three very similar black powder mills, which were demolished in 1994/5 along with the remainder of that Section to make way for the Western Ring Road. Two of the mills were removed to Tamworth, NSW, where a private collector and entrepreneur had plans — yet to come to fruition — to manufacture specialised grades of gunpowder. The remaining mill was dismantled and placed in storage on the Deer Park site of Orica Limited. However, it has since been scrapped.

In recent years the entire production facilities of the Maribyrnong Ordnance Factory, the Footscray Ammunition Factory, the St. Marys and Salisbury Explosives and Filling Factories, and several other interstate munitions works have been completely demolished. The basic explosives production facilities at Maribyrnong Explosives Factory and the ICIANZ/Nobel's Deer Park Explosives Factory have also been dismantled. The redevelopment of the Nobel site in Deer Park announced in 2015 now means that the Black Powder Mill of the former Albion Explosives Factory will be the only explosives production building surviving from Nobel's very long association with Deer Park. Therefore, in 2016, it takes on a new and important degree of significance.

The Mulwala Explosives Factory dating from World War 2 has undergone considerable renewal in the last 40 years. This and a new munitions factory erected at Benalla by ADI Ltd now replaces much of the former Commonwealth munitions

¹⁵ Personal correspondence from P. G. Jones, former HM Inspector of Explosives, UK to N. Tozer, 2003, covering advice from J. E. Dolan.

¹⁶ Shire of Braybrook Rate Books for these years, currently held by the Sunshine and District Historical Society as advised by Mrs Olwen Ford. Note: The National Trust of Australia (Victoria) Classification Report seems to imply these were Black Powder Works.

¹⁷ Personal correspondence from P. G. Jones, former HM Inspector of Explosives, UK to N. Tozer, 2003, covering advice from J. E. Dolan.

¹⁸ At the time 'diatomaceous earth' was generally referred to as 'infusorial earth'. It is also known as 'Fuller's earth'.

facilities.

Today, there is no surviving basic explosives factory building, commercial or government owned, with original plant from the World War 2 period or earlier in Australia and which is open to the public, apart from the Black Powder Mill of the former Albion Explosives Factory. The Defence site in Cordite Avenue, Maribyrnong has been assessed for heritage considerations and recommendations have been made for the retention of some process buildings. Their ultimate fate is not known. However, all plant has been removed from these buildings which are now only shells.¹⁹

3.3.3 Deer Park

The forerunner of the development of Deer Park, as a centre for the manufacture of explosives in Australia, may well stem from the formation of the Victorian Blasting Powder Company in January 1871 by several merchants.²⁰ Messrs Houghton, Longbottom, Masters and Peel were elected directors and it was decided to commence '*operations forthwith*'. Some difficulty was experienced in obtaining a suitable site. In 1871 Longbottom had been unsuccessful in obtaining permission to use Dight's Mill.²¹ However later, the company was able to either lease or purchase the land which the Government had licensed to a similarly named company, the De Lacy Patent Blasting Powder Company.²² It is not known whether De Lacy actually manufactured blasting powder which was intended to have guncotton and nitrates as the principle ingredients.²³

The site was on the bank of Stony Creek, presumably the northern one, around 'half a mile' (approximately 800m) from the Yarraville railway station and near the point where the creek enters the Yarra River, where the West Gate Freeway crosses the river. It would seem that '*Mr Longbottom*' was the driver of these activities as he is described as being '*ingenious*' and had kept working on his patented composition in his home at Emerald Hill (now South Melbourne) while negotiations for the site were being concluded. He experimented and '*the powder was getting rapidly into the market, especially at Bendigo*'.²⁴

A report in *The Age* of 16 April 1873 advised that at the moment only two men were employed and were producing two and a half tons (approximately 2500kg) each week. It was indicated that '*the machinery he required was very simple, his chief secret being the proportions used of charcoal, sulphur and saltpetre and two other secret ingredients found in the colony*'. This is clear evidence that black powder was being made on this site at this time. The report went on to describe the buildings at the Stony Creek as unpretentious iron sheds, in one of which '*the powder is made*'. The second shed had a press similar to that used in making guncotton cylinders. As there is no detailed description of any mill or other type of mixer, it is assumed that the process was a simple hand mixing operation similar in principle to a mortar and pestle.

These works would have been those noted in the above mentioned Report of the Victorian Inspectors of Explosives, 1879 located at Yarraville.

¹⁹ Personal correspondence from Mr W Paul, a former supervising engineer from EFM to NHT, June 2016.

²⁰ *The Age*, 5 January 1871, page 1, column 3 and 18 January 1871, page 2, column 6.

²¹ Milner, P., *op.cit*, page 320.

²² *The Age*, 16 April 1873, page 3, column 5.

²³ Milner, P., *op.cit*, page 320.

²⁴ *The Age*, 16 April 1873, page 3, column 5.

In 1873 '*Lithofracteur*' had been introduced to the colony for the first time.²⁵ Lithofracteur was the 'invention' of Friedrich Krebs of Cologne, Germany, consisting of a number of additives to nitro-glycerine to avoid infringement of Nobel's patents.²⁶ One of the first importers was Jones, Scott and Co of Market St.

When Longbottom's Victorian Blasting Powder Company became concerned about competition from this more effective blasting agent, the principals decided to form a separate company, but '*with the same experienced management*'. The Australian Lithofracteur and Nitro-Glycerine Compounds Company was formed and '*their experiments were commenced in June 1873*'.²⁷ These were presumably at the Stony Creek (Yarraville) site as the *Argus* report continued, noting that one of their major difficulties was the acquisition of a suitable site. The one eventually selected was described in 1875 as '*a long drive from Melbourne on freehold and not in the neighbourhood of the Victorian Blasting Powder Company*' (i.e. Yarraville).²⁸ The actual location was not given in order not to alarm the '*anxious traveller*'.

The description leaves no doubt that nitro-glycerine was being produced by the reaction of mixed nitric and sulphuric acids on glycerine, its subsequent washing and adsorption in diatomaceous earth. The company seems to have continued production until a 'destructive' fire in mid-September 1876 destroyed the plant.²⁹ The location of the works was given as between Braybrook and Footscray, about four miles (approx. six and a half km) from Footscray.³⁰

Further research will be necessary to establish its location and precisely when production of lithofracteur actually commenced at this site in Braybrook, but it is likely to have been early in 1875. The Balance Sheets and Profit and Loss Accounts for the years ending December 1874 and 1875 for the company show no sales for 1874 and sales of 'Litho-Fracteur' to the value of £3,010/12/- for 1875.³¹ This is a notable technological achievement for the Colony of Victoria, as it was only a very short time after Nobel's introduction of this process and of his similar product, '*dynamite*', on the world scene. This rapid transfer of technical knowhow across the globe so soon after its 'invention' should perhaps be more widely recognised. However, the company does not seem to have survived beyond 1876.

In June 1875, the actions of Longbottom and The Australian Lithofracteur & Nitro-Glycerine Compounds Company seem to have had a reaction on the major importers of Krebs' Lithofracteur from Germany, the firm of Jones, Scott and Co.³² This was probably increased by the imposition of a tariff on imported explosives by the Victorian Government.³³

The Australian Lithofracteur Company (Krebb's Patent) Limited, with a capital of £30,000, acquired the patent rights of Messrs Krebbs (sic) brothers and Co and with the goodwill and business of Messrs Jones, Scott and Co planned to produce '*a compound, Lithofracteur*'. Little time was wasted as by June, the company had purchased Peter Wilkie's farm of 63 acres (approx. 25 ha) at Koroit (sic) creek bridge

²⁵ *The Argus*, 14 February 1873, page 3, column 4.

²⁶ *Technology in Australia*, Australian Academy of Technological Sciences and Engineering, Melbourne, 1988, online 2000, updated 21 November 2001, page 609

²⁷ *The Argus*, 28 August 1875, page 10, column 3.

²⁸ *The Argus*, 28 August 1875, page 10, column 3. See also Shire of Braybrook Rate Books, 1874-1875,

²⁹ *Williamstown Chronicle*, 16 September 1876, page 3, column 4.

³⁰ *Ballarat Courier*, 11 September 1876, page 2, column 7 and *Australasian Sketcher with Pen and Pencil*, 30 September 1876, page 110, column 1.

³¹ Defunct Company File, VPRS 932, no. 327, held by the Public Record Office Victoria.

³² *The Age*, 31 May 1875, page 3, column 5.

³³ Reference needed.

and proposed the erection of a lithofracteur factory on the Derrimut side (the south) of the creek.³⁴

A later article, headed '*The Australian Lithofracteur Company's Works*' is more forthcoming with the location:-

*"The company's works are situated beyond Braybrook, and 10 miles (16 km) from Melbourne on the old Ballarat Road. Seventy acres (approx. 30 ha) of land have been purchased with a good frontage to Koroit (sic) Creek, which separates the works from the main road with which it is connected by a stout wooden bridge."*³⁵

Although the bridge is long gone, this description could almost be applied to the access to the Orica Limited site today.

This same article gives an excellent layman's description of the process for the manufacture of nitro-glycerine which when compared to current practices makes one realise the dangers the employees of the day faced. Not surprisingly, there were a number of accidents and in the period from 1892 to 1923, at least twelve fatalities occurred. All were related to the manufacture of nitro-glycerine or nitro-glycerine based explosives. Several of these gave rise to multiple casualties and were reported in the newspapers of the day.³⁶

The company's works and some of the background is given in the 1877 article. In 1875, Jones, Scott and Co invited a representative of Krebs' Bros to visit Melbourne to establish the factory and to produce nitro-glycerine and lithofracteur. He arrived in June and production commenced in April 1876. An advertisement appeared that same month.³⁷ It read:

'Lithofracteur, German and Australian Lithofracteur, Krebs' and Co.'s Patent,Agents and Manufacturers, Jones, Scott and Co.'

The significant difference to their earlier advertisements is in the inclusion of the word '*Manufacturers*'.

Thus April 1876 would seem to be the commencement of explosives operations in the Deer Park area which continued under various company structures until the early 21st century. This date is virtually confirmed in the evidence of Robert Steel Scott as 'Manager of the Australian Lithofracteur Company's works', to the 'Board Appointed to Make Enquiry into the Subject of Dealing with Explosives, 1882' in answer to a question where he stated that their work commenced in 'say May 1876'.³⁸

However, the date of the commencement of black powder production at Deer Park has not been established with the same certainty, although it is believed to have been in the late 1880s. Further research will be required to establish a more accurate date. Based on newspaper advertisements, it was between mid-February and mid-September 1889. Advertisements published by the then Australian Explosives and Chemical Company Ltd on the 14th February and 23rd September are virtually identical except for one detail.³⁹ They both list the products manufactured at the Kororoit Creek Works but the latter includes 'Blasting Powder' which is not listed on the earlier. The later advertisement continues until late-November 1891, but in early December 'Blasting Powder' is no longer listed as a manufactured product.⁴⁰ It is

³⁴ *Bacchus Marsh Express*, 12 June 1875, page 4, column 2.

³⁵ *The Argus*, 5 January 1877, page 6, columns 6 & 7.

³⁶ *The Age*, 5 April 1892, page 5, column 5; 2 August 1898, page 5, column 5; 23 August 1916, page 8, column 3; 17 January 1923, page 9, columns 1 & 2 and 21 November 1923, page 11, columns 8 & 9.

³⁷ *The Argus*, 21 April 1876, page 3, column 3.

³⁸ Victorian Parliamentary Papers, VPARL1882-83 No 1, Public Record Office, Victoria, Minutes of Evidence, Question 9, page 1.

³⁹ *The Age*, 14 February 1889, page 1, column 7 and 23 September 1889, page 2, column 8.

⁴⁰ *The Age*, 2 December 1891, page 1, column 6.

merely 'on hand'. Presumably this indicates the cessation of manufacture at Deer Park and a reliance perhaps on imported material.

On these assumptions, black powder was manufactured at Deer Park for only a short period of about 26 months from mid-1889 to late-1891.⁴¹ It has also been variously stated that production ceased in 1892 as a result of an accident, however as noted above, the accident in April 1892 occurred when cartridgeing 'pebble powder', a nitro-glycerine based explosive.⁴²

Again further research would be necessary to determine the reasons behind both the commencement and shutdown of this process. A reproduced drawing of the layout of the process building has been provided by Orica Limited from their Archives and is included as Image 10, Appendix 1. It shows a substantial long rectangular multi-bay building with three of the bays each designated 'Mill' separated from a press bay and a drying bay by an 'engine room' which is supplied by steam from a boiler house at a distance of 200 feet (approx. 61m). Each bay was separated by a 6 feet (approx. 1.8m) wide gap with some type of blast wall constructed in that space. What is probably a stationary steam engine would drive the depicted line shaft passing through each bay and any machine in the bay would be driven by belts. The building was 52 feet (approx. 16m) from Kororoit Creek and 427 feet (approx 137m) from the nearest point of the boundary fence. The noting of these distances indicate that this siting was required to meet appropriate safety distances for that time. This shows that the Blasting Powder plant was a substantial investment which makes its closure more interesting and very worthy of further research.

A note on the drawing refers to Blasting Powder being 'pulverised nitrates, carbon and sulphur', the traditional ingredients of black powder and was produced in 'pellet form'. The note on the drawing that *'production was abandoned after a triple fatality and black powder was not made again at Deer Park until 1936'* is believed to be incorrect. (See Footnote 41)

Production resumed in 1936 when it became more difficult to import sufficient to meet the local needs following the closure in 1934 by ICI UK of the powder mills at Faversham, Kent. The Faversham Mills had been producing gunpowder since the 16th century.⁴³ The UK production was being consolidated at Ardeer in Scotland.

As noted previously, this modern black powder plant continued operation until 1970. In the 1960s about three quarters of the production was for the production of safety fuzes at the ICIANZ factory in Footscray while the remainder was used for defence purposes, blasting powder in civil applications and harpoon heads for the Western Australian whaling industry.⁴⁴

The Section was dismantled, the equipment sold and the buildings demolished to make way for the Western Ring Road in the mid-1990s. No trace remains.

⁴¹ However, a list compiled by the late David Meale, formerly of ICI Limited, and supplied to Olwen Ford indicates that black powder production halted in 1892,

⁴² Note: The confusion appears to have arisen from the use of the term 'pebble powder'. This term has been used for slow burning large grained gunpowder. See Websters Online dictionary at <http://www.finedictionary.com/Pebble%20powder.html>. However, the Report of the Inspector of Explosives for 1892 (VPARL, 1893 No 29, page 8) clearly states that the accident occurred during the cartridgeing of 'pebble powder', which is described as consisting of a mixture of nitro-glycerine, charcoal and potassium nitrate.

⁴³ Percival, A J *Faversham Gunpowder Industry, About Faversham No 4*, The Faversham Society, Faversham, Kent, UK, 3rd Ed, 1986. Copy provided by PG Jones, former Inspector of Explosives, UK, to N Tozer, 2003.

⁴⁴ ICIANZ Circle, 12 February 1960, page 4.

3.3.4 Albion Explosives Factory

The restored Black Powder Mill, Fuze Powder Section Mill House, Building No 745, is all that now remains of the Albion Explosives Factory. The purpose built building and mechanical plant designed specifically for safe manufacture of explosives is worthy in its own right for heritage listing but it is also representative of the wider explosives manufacturing facility that was once Albion Explosives Factory as outlined in this history. The condition of the Black Powder Mill House as it was shortly after the closure of the Factory in 1986 can be seen in Photograph 1, Appendix 2.

During and following World War 2, Albion Explosives Factory was a significant producer of TNT (High Explosive) and Cordite (Propellant) in Australia. The extensive layout of the Factory shortly before closure is shown in Images 4, 5 & 6, Appendix 1.

At the opening of the factory in 1939, nitric acid was produced by the reaction of concentrated sulphuric acid on sodium nitrate (Chile saltpetre) giving rise to gaseous nitrogen oxides which were absorbed in water to make nitric acid of a strength around 50 to 55%. This was then concentrated to 95+% and mixed with concentrated sulphuric acid for use as the nitrating acid for nitro-glycerine and TNT production.

In 1937, ICIANZ had sanctioned the building of a plant for the continuous production of synthetic ammonia from coal, steam and air on their Deer Park site. However it was not until 1940 that this plant and the associated ammonia oxidation for the production of nitric acid were completed. These were originally intended for the commercial explosives business but the output was directed towards wartime requirements.⁴⁵

In addition, ICIANZ constructed an identical ammonia oxidation plant for acid manufacture at Albion Explosives Factory. Plants were also erected at Mulwala Explosives Factory, Villawood in NSW and Salisbury in SA. In 1952, the Albion factory area was enlarged with the acquisition of land north of Furlong Road to accommodate a new facility for the continuous production of the high explosive commonly known as RDX which had been developed by the UK prior to World War 2.

Within this new facility were four batch operated drying/mixing plants for the mixing of RDX with TNT to form the high explosive composition used for shell and bomb filling. With four plants operating in sequence, the output of RDX/TNT became continuous. The processes of shell and bomb filling were conducted at Explosives Factory Maribyrnong (EFM) and Munitions Filling Factory, St Marys, NSW, (MFF).

Additional production facilities were progressively added at Albion, including a continuous Biazzi nitro-glycerine production plant (1959), additional propellant extrusion presses for solid rocket motors (1959) and a dinitrotoluene (DNT) plant (1962).

At the cessation of World War 2, the production of nitric acid ceased at Albion Explosives Factory and supply was obtained from the identical ICIANZ constructed plant at Mulwala Explosives Factory. Through regular road tanker deliveries the acid delivered was at either 98.5% or 57% strength which was concentrated at Albion to the strengths required for RDX and nitro-glycerine production. Nitric and sulphuric acids and oleum were mixed to provide the nitrating mediums for nitro-glycerine and TNT.

⁴⁵ Technology in Australia 1788 – 1988, Australian Academy of Technological Sciences and Engineering, Melbourne 1988, page 636, at <http://www.austehc.unimelb.edu.au/tia/636.html>, accessed June 2016.

In the 1970s, construction continued, with a new continuous TNT production plant (1973), a new acid re-concentration plant specifically for handling the RDX acids (1975), an RDX recrystallisation plant (1976), a new semi-continuous RDX/TNT drying and mixing plant (1977) and two specific purpose effluent treatment plants after the Deer Park area was provided with a main sewer by MMBW in 1980. In the modernisation of all these plants, safety was of prime consideration with the minimization of the amounts of bulk pure explosives and increased instrumentation with the provision of many inter-locking safety devices.

The technical resources to design, construct, install and commission these chemical plants was provided by the Commonwealth Department of Supply Explosives Branch personnel at Explosives Factory Maribyrnong and all building works were contracted by the Commonwealth Department of Works. The Buildings and Property Division of the Explosives Branch ensured that buildings and services constructed for processing explosives complied with all safety standards and were supplied in a timely manner for plant installation.

Pressures from the surrounding development of housing together with the associated infrastructure of schools and shopping complexes where people could congregate forced the closure of the Factory in 1986. Explosives production had no place in what had become an urban environment. The situation can be seen in the area map, Image 6, Appendix 1.

The site was remediated by contractors for the Department of Defence and is now the residential suburb of Cairnlea.

3.3.5 The Black Powder Mill – a Chronology⁴⁶

BACKGROUND

- 1875 Jones, Scott & Co. signs an agreement with Krebs Bros & Co. of Cologne and seeks permission from Braybrook Shire Council to establish an explosives factory near Kororoit Creek.
Australian Lithofracteur (Krebb's Patent) Company formed.
German experts set up factory to make the nitro-glycerine based explosive, 'lithofracteur.'
- 1876 Factory commences production and becomes Australia's main local supplier of explosives.
- 1882 52 people working at the Lithofracteur factory (See Royal Commission on Tariffs).
- 1889 Township of 'Kororoit Creek' is re-named 'Deer Park' after a local referendum.
- 1889 Black Powder (blasting powder) production commences at Deer Park site.
- 1891 Black Powder production ceases at Deer Park site.
- 1897 Nobel Dynamite Trust Ltd buys Australian Explosives & Chemical Company Limited.
- 1928 ICIANZ acquires Nobel factory at Deer Park
- 1935 Three black powder mills built at ICIANZ, Deer Park factory, south of Ballarat Road.

WARTIME

- 1939 Outbreak of World War Two
Munitions factories in Melbourne's west are the centre of national defence production.
ICIANZ builds and operates a new explosives factory at Deer Park for the Commonwealth Government, north of Ballarat Road: 'Armament Annexe No 29', later known as 'Government Explosives Factory No 5, Albion', then 'Albion Explosives Factory (AEF).

⁴⁶ This outline prepared by Olwen Ford, Friends of the Black Powder Mill Incorporated, June 2005, amended 2016

- 1942 Japanese bomb Darwin.
ICI/ANZ builds Black Powder Mill (numbered 'Z9' later '745'), one of 33 buildings in the Fuze Powder Area of the new factory, to make fuze powder used in time-ring fuzes, mainly for artillery ammunition.
- 1944 Explosion in 'Gunpowder Mill House Z9' (18 May). Light wall is blown out. Roof collapses. Mill is not damaged. Robert Taylor has serious burns and dies in hospital on 21 May. Richard Mitchley has minor injuries. Steel scraper found in building.
- 1945 End of World War Two.
Fuze Powder milling ceases at Albion Explosives Factory.

POST-WAR

- 1948 ICI/ANZ transfers management of Albion factory to the Commonwealth.
- 1954 Albion Explosives Factory expands. New plant, including RDX-based high explosives.
- 1957 220 people working at Albion factory.
- 1960s-70s New plants for Nitroglycerine, DNT and TNT installed. Other upgrades implemented.
- 1970 Black Powder production ceases at ICI/ANZ site
- 1986 Albion Explosives Factory closes. Some production processes transferred to Mulwala Explosives Factory (MEF), (NSW).
- 1988 Decommissioning and demolition of factory buildings begins and proceeds over the next ten years. Planning begins for re-development of the site as a residential area.
- 1994 Black Powder Mills at ICI Australia site demolished to make way for Western Ring Road.

DOCUMENTING, SAVING & PRESERVING THE MILL

- 1987-8 Albion Explosives Factory Heritage Study by Gary Vines and Andrew Ward.
- 1988-9 Heritage Survey of Albion Explosives Factory by Sheryl Yelland.
- 1997 Brimbank Heritage Study points out national significance of the mill.
- 1998 Albion Explosives Factory site, including Black Powder Mill, placed on Register of the National Estate.
- 1999 Black Powder Mill added to heritage overlay of Brimbank City Council planning scheme.
- 2001 Partial demolition permit issued by Brimbank City Council.
Friends of the Black Powder Mill formed.
National Trust of Australia (Victoria) classifies the mill as of national significance.
- 2002 Brimbank City Council invites views of local residents and interested parties on the future of the Black Powder Mill. Friends of the Black Powder Mill produce brochure.
- 2003 Mill included on Victorian Heritage Register. Heritage Victoria grants \$11,000. Brimbank City Council commissions new Conservation Management Plan for the mill and contributes funding for its restoration. Launch of restored building by Professor G. Blainey.
- 2004 Grant of \$48,840 from Department of Environment & Heritage.
- 2005 ADI Limited donate motors and make replica tools. Restoration of machinery and shadow board.
Launch of restored machinery and new signs by Professor Ian Rae.
The mill wheels turn again, started by Gary Vines.
- 2005 to Present Friends of Black Powder Mill Incorporated continue with regular public access Open Days at least twice each year. Brimbank City Council maintains the Mill building and machinery.

3.4 Heritage Listings

3.4.1 Heritage Victoria

Name

Black Powder Mill

Location

PARKLEA AVENUE AND GRASSY POINT ROAD, CAIRNLEA

Municipality

CITY OF BRIMBANK

Level of significance

Registered

Victorian Heritage Register (VHR) Number

H2029

Heritage Overlay Numbers

HO6

Heritage Listing

Victorian Heritage Register

3.4.2 The National Estate

Name

Albion Explosives Factory (former) Historic Elements

Location

Ballarat Road, Deer Park, Vic, Australia

List

Register of the National Estate (Non-statutory advice)

Class

Historic

Legal Status

Registered (27/10/1998)

Place ID

17992

Place File No

2/12/051/0003

Accessed

June 2016 at

http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=place_name%3DAlbion%2520Explosives%2520Factory%3Bstate%3DVIC%3Bcountry%3DAustralia%3Blist_code%3DRNE%3Bkeyword_PD%3Don%3Bkeyword_SS%3Don%3Bkeyword_PH%3Don%3Blatitude_1dir%3DS%3Blongitude_1dir%3DE%3Blongitude_2dir%3DE%3Blatitude_2dir%3DS%3Bin_region%3Dpart;place_id=17992

3.4.3 City of Brimbank

Name

Black Powder Mill

Location

Parklea Avenue; Kororoit Creek, CAIRNLEA

Heritage Status / Level of Significance

Included in Heritage Overlay

Heritage Inventory (HI) Number**Listing Authority**

HI

Heritage Overlay Number

HO006

4 Assessment of Significance

4.1 Historical significance

The Black Powder Mill, Building 745, was planned and constructed at a time of great uncertainty in 1941/2. The Japanese had attacked Pearl Harbor, Hawaii in December 1941 and were advancing through south-east Asia. Singapore fell in February 1942. Australian troops were engaged in battles across the north of Africa and the overall wartime situation was very uncertain.

The Mill therefore represents a phase in the defence of Australia when local manufacture of military materiel was an absolute necessity. Although black powder was not required in great quantities, it was an essential ingredient in the production of time-ring fuzes for artillery ammunition and aerial bombs. It was being supplied by the facility at ICIANZ at Deer Park but, with the situation in the Pacific Ocean becoming an unknown quantity, an increase in output was needed.

The Mill now stands as the sole reminder of the Albion Explosives Factory which played a key role in the local production of propellant and explosives during the later stages of World War 2, then through the Vietnam War until its closure in 1986 due to pressure from urban development.

This same urban development but coupled with a change in technology has led to the closure of explosives manufacture at the Orica Limited site, south of Ballarat Road. No process building has been listed for heritage retention. Hence the Black Powder Mill, designed and constructed by ICIANZ is now the sole surviving example of explosives production which commenced in Deer Park in 1876.

The Australian Lithofracteur Company (Kreb's Patent) Ltd commenced the manufacture of nitro-glycerine based blasting compositions in 1876 also manufacturing Blasting Powder (black powder) from 1889 to 1891. Production of black powder on the site

was suspended until ICIANZ constructed a new facility in 1935 which continued in operation until its closure in April 1973.⁴⁷

4.2 Historic Individuals or Association

As black powder has a history in the Western world which extends over at least eight centuries, many improvements and developments have occurred and it is not possible to note those individually responsible.

One of the earliest records is by Friar Roger Bacon in 1242 where he also noted its composition.⁴⁸ In UK, black powder has been produced at the Waltham Abbey Royal Gunpowder Mills since 1660.⁴⁹ Here alder trees were grown for charcoal and fresh water was abundant. It has been used since the mid-14th century by England's armies under King Edward III in frequent conquests of the Low Countries.⁵⁰ It was used for mining in Cornwall in 1689.⁵¹

Mercer reports that the first significant industrial application of black powder in Australia was the construction of an approximately 3½ km long tunnel from 1825 to 1837 as Sydney's second water supply, known as Busby's Bore under the supervision of John Busby, Government Mineral Surveyor.⁵²

Similarly the plant installed is a very old technology. It is an Edge-Runner Mill where heavy vertical wheels are driven round a flat bottomed bowl containing the material to be ground and mixed. The grinding action is achieved by both pressure and shear but is only suitable for 'non-sticky' substances. It has been used in many industries from the grinding of corn in a windmill or watermill, the extraction of oil from seeds, of juices from fruit, the crushing of mineral ores, the extraction of gold from quartz and in the preparation of pharmaceutical compositions. The Romans were using edge runner mills to produce olive oil at the time of Christ and a report indicates the Chinese may have been utilising this type of mill in the 3rd century. The design is also referred to as a 'Chilean Mill'.⁵³

During World War 2 when this plant was selected as the appropriate technology, the decisions would have been made by the responsible officers and managers in the relevant Commonwealth Departments and Directorates, the Explosives Factory Maribyrnong and particularly, ICIANZ on whose recommendation would have been critical. The latter company, which was operating black powder mills at Deer Park as well as the Explosives Annexe No 5, would have had the major input. Mellor in his history, *Australia in the War* comments 'ICI Australia was able to provide valuable assistance to the Government during the war. Moreover, the company could call upon the great fund of technical experience of its parent organisation' which was of course, ICI Ltd in UK.⁵⁴ Unfortunately those actually involved are not known.

⁴⁷ Advice from Sheryl Holschier, Library Services, Orica Limited, personal correspondence to Noel Tozer, June 2016.

⁴⁸ Mercer, J. K. E., *History of Industrial Explosives in Australia*, ICI Australia Operations Group, 1989, Appendix 1.

⁴⁹ Meade, Andrew, *The Architects' Journal*, 5 June 1997, pages 27ff.

⁵⁰ De Vries, K, *Gunpowder Weaponry and the Rise of the Early Modern State*, page 139 at <https://www.amazonaws.com/Primary+sources/GunpowderEMState-MR.pdf>, accessed June 2016.

⁵¹ Mercer, J K E, op.cit.

⁵² Mercer, J. K. E. *ibid*, page 2 and Sydney Water at https://www.sydneywater.com.au/web/groups/publicwebcontent/.../dd_044107.pdf, accessed June 2016.

⁵³ See Appendix 5.

⁵⁴ Quoted from *Technology in Australia 1788 – 1988*, Australian Academy of Technological Sciences and Engineering, Melbourne 1988, page 611, at <http://www.austehc.unimelb.edu.au/tia/611.html>, accessed June 2016.

4.3 Creative or Technical Achievement

The major technical achievement in the manufacture of black powder in Australia was the preparation of suitable grades of charcoal using wood which was available locally.

J E Dolan of Ardrossan has provided the following comment on the role of charcoal in the performance of black powder.⁵⁵ He is of course referring to European conditions.

“The properties of blackpowder depend considerably on the charcoal used. Soft woods free from bark give the best results. Elder wood and dog wood are best but the cheaper birch and beech are frequently used for ordinary purposes. In any case it is important that the wood should be carbonised to the correct extent and this depends on the nature of the wood. In the case of elder wood the optimum carbon content is 74%, whereas with birch a figure of 82% gives the best results. In general, if the carbon content is too low a readily ignited blackpowder is obtained but it has slow burning properties. It is also difficult to manufacture. If the carbon content is too high (the) material is easy to grind and milling is rapid, but the final blackpowder may be difficult to ignite and irregular in burning.”

From this it is clear that a consistent reliable source of charcoal is crucial for the production of black powder for use in the fuze systems necessary for the repeatable performance of artillery shells and bombs.

Unfortunately, again the details of the trials on various Australian woods are not known but the amount of rigorous testing and proof firings which must have occurred can be readily imagined.

4.4 Research Potential

An important avenue for further research in regard to the Black Powder Mill, Building 745, exists in establishing the precise necessity for this additional capacity for fuze powder. Following this, the identification of the persons involved in the decisions to build the Mill at Albion and not at the Nobel's site would be of importance and then to follow this with investigating the companies involved in the construction of the actual building and the installation of the plant. Relevant persons could include N Taylor, A E Leighton, T S Donaldson and N K S Brodribb as well as many others.

An interesting question might be whether ICIANZ had had this particular mill in storage in Australia as a spare from the construction of the Deer Park plant in 1935 in case of an accident. Or, was it imported during the war and, if so, how? It is suspected that the former is the more likely scenario.

A second avenue of research could be to trace the process of investigation into the selection of which Australian wood was to be used for the manufacture of charcoal.

A further aspect could be to establish the commercial arrangements between the Commonwealth of Australia and ICIANZ for the construction and operation of the Albion Annexe from 1938 to the cessation of hostilities in 1945 and from that time until the Commonwealth resumed responsibility in 1952.

Historically, research could be carried out on the companies involved in the early production of Blasting Powder as mining moved away from alluvial methods to below ground extraction. Many people would be involved and names like Mark Gardner, Charles (?) Longbottom, T. Tolley Jones, Robert Scott and Krebs's chemist, Herr Engel, come to mind.

Similar historical research could be the investigation of the methods and equipment which these companies used in the manufacture of blasting powders and their compositions.

⁵⁵ Dolan, J., E., personal correspondence to Noel Tozer 29 October 2003.

4.5 Social

The Black Powder Mill has the potential to keep before the public the important work which was conducted by the munitions workers in the western suburbs of Braybrook, Footscray, Maribyrnong and Deer Park. It is also a reminder of the part played in the defence of Australia by the establishments in which they worked in the supply of ordnance, ammunition and related materiel to the forces.

An interesting example arose during one recent Open Day, when the Mill was visited by an elderly gentleman whose father had lost his life in an explosion in one of the ICIANZ mills at Deer Park. This gentleman had only a vague recollection of his father but he expressed his feeling of closure by being able to see a mill and to learn something about black powder.

Very frequently visitors ask questions regarding the operations which were carried out at Albion Explosives Factory and almost always, they have wondrous tales of *'tunnels'*, *'men in white suits'* and other mysterious goings-on. It is gratifying to see the looks of relief when we are able to explain the products made by the factory in simple everyday terms.

4.6 Rarity

The Black Powder Mill is understood to be one of the last such mills built and is probably the last one built solely for military products. It is therefore rare.

It is also rare in that it is a surviving example of an actual explosives processing building with intact plant and which can actually be seen operating almost as it did. This has occurred because of the nature of black powder, being composed of three non-explosive ingredients and a building constructed in such a manner that was very easy to clean and decontaminate to be able to certify it as being free from explosives. It is therefore safe for visitors.

The plant is a rare example of a surviving centuries old technology which has been in use in a wide variety of industries, but has now been superseded by modern equipment.

No other similar installation is known in Australia.

4.7 Representativeness

The Mill is representative of an explosives processing building and able to demonstrate the engineering design principles and philosophy used in its construction and operation.

4.8 Integrity/Intactness

While the remainder of the Albion Explosives Factory has been demolished and has become the residential suburb of Cairnlea, this particular building is substantially intact. If several supporting buildings such as the Preparation House had been preserved the site would have been more interesting.

However as an edge runner mill with the associated drive mechanism in place and operable, it is an interesting and significant example of old technology which has been adapted to meet modern safety standards. If the product were required today, it is believed the process could be readily adapted to meet current safety standards.

5.0 Statement of significance

The Black Powder Mill was originally a major production unit of the former Albion Explosives Factory at Deer Park on the western outskirts of Melbourne. It is now the only remaining one of the more than 400 original buildings and the only example of an explosives production facility with original plant in place able to be operated and visited by the public in Australia.

As a process building, together with the Mill itself, with its siting within the Factory complex and also in relation to the community in general, it succinctly demonstrates the engineering design principles and standards developed and adopted by engineers and architects over a long period of time. These principles ensure the safety of the operation, the workers involved, the nearby neighbourhood and allow the other production processes on site to continue operating as close to normality as possible. These are summarised in the following.

- The Factory was sited in an undeveloped area sufficiently remote from built up development yet close enough for access by the labour force and proximity to suppliers of goods and services.
- It was located near the extensive resource of knowledge of technical support and knowhow provided by the long operating private explosives manufacturer, ICIANZ which was centred in Deer Park and the Commonwealth of Australia Explosives Factory Maribyrnong, established in 1908-1912 and operating continuously to that time.
- Within the factory, for all explosives manufacturing operations, each operation was confined to a dedicated process building, in order to restrict the extent of damage in the event of an accident. The milling of black powder was the only operation carried out in this building.
- The other operations involved in the manufacture of black powder, viz ingredient preparation, millcake breaking and pressing, corning, glazing, sieving, conditioning and packing were each carried out in separate subsequent buildings which extended in a line in a northerly direction from the Mill.

- Each explosive product was produced in a Section dedicated to that product. The process workers likewise would only work on that particular Section utilising separate changerooms and facilities to prevent any cross contamination from one product to another or from the various raw materials.
- For similar reasons, the protective clothing worn on each Section was designed to suit that product, but followed general principles. The fabric was woollen which was difficult to burn and, as distinct to cotton fabrics, was more resistant to the acids used in many operations and would not form nitro-cellulose as readily. No buttons or pockets were permitted and the trousers/slacks worn by all workers were secured by ties. No jewellery could be worn other than wedding rings and these only if they were securely taped. Footwear was either rubber or leather boots with no nails or eyelets and no aglets to the laces. A process operator wearing 'danger building' clothing glazing black powder with graphite is shown in Photograph 2, Appendix 2.
- No smoking or the carrying of matches was permitted in any of the designated 'Danger Areas'.
- These general principles led to the factory occupying the large area. For the duration of World War 2, the almost square site was bounded roughly by Ballarat Road and Kororoit Creek on the south, Station Road to the west, Furlong Road to the north and other properties on the east.
- The administrative offices and essential services were located near to Ballarat Road on the southern edge. The central briquette fired boiler house for steam for process heating was located here. These important facilities were remote from the explosives production sections.
- Black powder must not contain any impurities and, in such situations, the presence of any grit or metallic particles would sensitise the powder increasing the possibility of an accidental explosion. Over the long history of the manufacture of black powder, many accidental explosions have occurred so, as a precaution, the Section, as a whole, was sited remotely from the remainder of the factory, particularly the boiler house where grit might be expected to be discharged from the chimney.
- Within the Section, the Mill was sited as the first building in the processing line with only one adjacent process building. This building was protected by a concrete blast wall 3 feet (912mm) thick and approximately 15 feet (4550mm) high which formed two walls of the Mill building. The roof and the remaining walls were of frangible timber construction so that in the event of an accidental explosion, the blast would be directed away from the other process buildings and personnel. The Section support buildings, the stores, office, changerooms, canteen and the preparation of the non-explosive ingredients were all located to one side, the west, of the Mill and not in a direct line. The effect of any blast was thereby minimised. The layout of the Fuze Powder Section is shown in Image 7, Appendix 1. Each building was separated from its neighbours by the appropriate 'Safety Distance' which was dependant on the type and quantity of material in the building, the processes being conducted in each building, the form of protection between each building and other related considerations.
- The design of the Black Powder Mill House follows the accepted long established design principles for explosives processing buildings.
- The Motor Room is completely separate from the Processing Bay, being located in an under floor basement. It contained all electrical equipment, the drive motors and associated reduction gearing and drive system, thereby preventing any explosive material coming in contact with this equipment. It also prevented any lubricant, rust or

other foreign from entering the black powder during processing. The design of the two bay concrete structure is shown in Image 8, Appendix 1.

- The Processing Bay was designated 'Clean Area' and strict 'rules' applied. A 'Use List' itemised the tools and equipment which were permitted in that Bay and no other item could be brought in without special permission. All tools were allocated positions on a shadow board so that any misplaced tool could be readily identified and located. The 'Operating Instructions' detailed the procedure which had to be followed when processing black powder. No other operation could be conducted without special permission. For example, the tools for handling black powder were only made of wood or non-sparking metals such as copper and its alloys. Similarly, any repair or maintenance work required certification by at least two Authorised Persons who determined the methods to be followed and the tools to be used.
- The physical design of the Process Bay followed strict principles. The internal surfaces had a smooth finish for ease of cleaning. All joints and cracks were taped over to prevent ingress of black powder or the accumulation of dust. The concrete floor was covered with bitumastic felt (Malthoid) laid on a bitumen base with the joins of the sheets sealed with bitumen. This allowed for ease of cleaning and prevented pockets where black powder could be trapped. The corners where the floor met the walls were coved for ease of cleaning. Lighting was by external electric lights which shone through 'cellulose acetate' window panes set in canvas frames when required. The door furniture was of non-sparking brass.
- The design of the Mill machinery also followed strict principles. Within the Process Bay there is no point where any moving part can have an 'iron-to-iron' contact. The iron Mill wheels are suspended above the cast iron bowl and the ploughs to move the black powder under these wheels are of phosphor bronze. A General Arrangement drawing of a similar under-driven mill which was operated by ICI UK at the Ardeer Works, Scotland is shown at Image 9, Appendix 1.
- The bowl in which the black powder is milled is of open design so that if an incident occurred to ignite or initiate the Powder, the event is not confined except in the area beneath each wheel. In this way progression to an explosion as distinct from a rapid burning is much less likely to occur, thereby lessening the effect of the incident.
- The Mill is fitted with a simple drenching system which, while not intended to prevent the Powder from igniting, would dump water onto the Mill and the floor and go some way to preventing the spread of fire to other combustible materials.

In summary, the Black Powder Mill, as it now stands, exemplifies the Engineering Design Principles which have become standard for an Explosives Processing Operation. These encompass the location of the Building in the wider community and within the Factory Complex, the construction a two-bay building separating the processing from the mechanical drive equipment, the method of construction of the processing bay and the detailed consideration of the method by which the dangerous process should be operated and controlled.

Several photographs with captions are included in Appendix 2.

6.0 Area of Significance.

This project should be recognised as being of national significance.

This is due to the fact that the Black Powder Mill at Cairnlea is the only remaining explosives process building still containing its original plant, which can be viewed by the public from the area which was the major explosives manufacturing and design centre of Australia for a century from the 1870s through to the mid-1980s and often designated “Australia’s Arsenal”.⁵⁶ A map of the City of Footscray and the Shire of Braybrook in the late 1940s, showing these factories is at Image 9, Appendix 1.

It has been suggested that *‘the surviving building at Albion, erected in 1942, represents the last black powder mill to be established in Australia and, evidently, one of the last in the world.’*⁵⁷

From this area in the western suburbs of Melbourne a number of other explosives factories were established in Victoria, South Australia and New South Wales to meet the demands of World War 2 using the engineering design principles as identified here. The Mill played a crucial part in World War 2 supplying black powder for use in artillery and bomb time-ring fuzes when this material could no longer be imported. Being built in 1942 as part of this expansion, it may be the last Black Powder Mill built solely for military purposes.

It has been saved and refurbished and is now recognised as a tribute to the at least 25,000 workers in the Munitions Industry in the western suburbs of Melbourne during World War 2.

A second area of national significance is to recognise the part that explosives played in the nineteenth century development of the Colony of Victoria, and subsequently Australia, through their use in gold mining, creating immense wealth and prosperity in the fourth quarter of the nineteenth century. Gold could not have been extracted from the hard rock conditions without these materials.

It is also a reminder of the parts played by the several companies which produced explosives for civilian use and were located in the nearby areas of Yarraville, Braybrook, Footscray, Maribyrnong and Deer Park. These included the Colonial Ammunition Factory in Footscray (later the Ammunition Factory Footscray), the Commonwealth of Australia Explosives Factory, Maribyrnong and the Defence Standards Laboratories, Maribyrnong and the many small private companies which manufactured blasting powder and other compositions for use on the gold fields and on related projects such as the Victoria Patent Blasting Powder Company and, significantly Jones, Scott and Company (later to become the Australian Lithofracteur Company (Krebs Patent) Ltd, later the Australian Explosives and Chemical Company Ltd, later Nobel (Australia), later ICIANZ, then ICI Australia Limited and finally Orica Limited), manufacturing at Deer Park for over 125 years.

Engineering Heritage Recognition is sought to recognise the contribution of the very large but generally unknown industrial chemists, chemical, civil, electrical and mechanical engineers, architects and process operators to the design, construction and continued safe operation of these establishments.

⁵⁶ Ford, O., *Harvester City, The making of multicultural Sunshine, 1939 ~ 1975*, Sunshine and District Historical Society, Incorporated, 2012, Chapter 3, pages 35ff.

⁵⁷ Wixted, D., (Heritage Alliance), *Black Powder Mill, Grassy Point Road, Cairnlea., Conservation Management Plan, prepared for City of Brimbank*, September 2003, pp. 21–29.

A detailed comprehensive assessment of the significance of the Black Powder Mill is included in the Conservation Management Plan prepared for Brimbank City Council.⁵⁸

7 Interpretation Plan

7.1 General Approach

Interpretation will be by: marking the Black Powder Mill with an appropriate category of heritage marker; a public ceremony to unveil that marker; and an interpretation panel which summarises the heritage and significant features of the Mill for the public. This panel will complement the existing interpretive panels placed at the Mill by Brimbank City Council.

The ceremony should be held on **Saturday 12 November 2012** which is close to the anniversary of one of the more notorious planned usages of black powder by Guy Fawkes and his associate conspirators in the Gunpowder Plot of 1605.

This would not interfere with either the Melbourne Cup weekend or the currently planned Open Day of the Black Powder Mill on 22 October 2016 in conjunction with the Royal Historical Society of Victoria Heritage Week.

The interpretation panel could be located:

- a) Adjacent to the fenced area surrounding the Black Powder Mill near the entrance gateway and visible from the walking and cycle pathway following Kororoit Creek.
- b) It should not be placed away from the Mill building.

The heritage marker could be attached to the lower portion of the base of the Interpretation Panel. Or alternatively, with the permission of Heritage Victoria, it could be attached to the southern end of the western section of the concrete blast wall.

7.2 General Attributes of the Interpretation Panel:

- 1) A title “**Engineering Heritage**”. This title has been provisionally selected to distinguish it from the two new panels titled “**Albion Explosives Factory**” and “**Black Powder Mill**” respectively which are currently being replaced by Brimbank City Council following graffiti damage.
- 2) Logos of Engineers Australia, Friends of the Black Powder Mill, Incorporated and the Brimbank City Council.
- 3) Logos of the organisations which have financially supported the nomination of the Black Powder Mill, anticipated to be Commonwealth of Australia Department of Defence, Orica Limited and Thales Group.
- 4) A small scale representation of the EHA marker plate.
- 5) The date and other details of the marking ceremony.
- 6) Text should be 24 point Arial Bold.
- 7) Brief captions for each photograph.

⁵⁸ Wixted, D., op. cit.

7.3 The Interpretation Panel:

- 1) Size to be nominally 605 mm wide by 900 mm high.
- 2) The design should be in an identical style to the replacement interpretation panels.
- 3) The text and images are to be on anodised aluminium with an anti-graffiti polyurethane clear coating as per drawing at Appendix 4.
- 4) The text and images panel is to be the same size as those on the replacement panels and is to be placed on the inclined upper surface of the base.
- 5) A draft possible panel is shown at Appendix 4.
- 6) The panel to be mounted on a base structure of “Corten” steel, allowed to rust and stabilise and set in concrete as per drawing at Appendix 4.
- 7) The title on the base structures to be laser cut through the steel.
- 8) A second smaller acknowledgement panel of the same material to be mounted on the vertical section of the base incorporating the logos of the several supporting organisations as listed above. The EHA marker to be mounted either on or adjacent to the second panel as shown in Appendix 4.

7.4 Possible Themes for Interpretation Panels

The following subjects have been assessed as themes for inclusion in the text for the interpretation panel:

- a) A short history of black powder from the 10th century and of edge runner mills from Roman times.
- b) The use of black powder in the development of mining and civil engineering projects in Australia and particularly Victoria.
- c) The role of both the explosives and munitions industries in the western suburbs of Melbourne.
- d) The recognition of the Black Powder Mill as the sole remaining process building with intact plant as a reminder of these industries and of the people who designed, constructed and operated these many facilities.
- e) Two photographs/illustrations to be included to show the use of black powder in civil and military applications together with one photograph of the mill illustrating an edge runner mill.
- f) Total text should be approximately 300 words excluding headings.

7.5 Preliminary Text Blocks for Interpretation Panels

7.5.1 Proposed Text

The following draft text is proposed for consideration for the Interpretation panel. A possible layout is shown in Appendix 4.

ENGINEERING HERITAGE

Black powder has several names and uses:

gunpowder when used as a propellant;

fuze powder when used as a delay;

blasting powder when used as an explosive in military, mining and civil engineering applications.

Each is an intimate mixture of saltpetre (potassium nitrate), charcoal and sulphur. It was known to the Chinese over 1000 years ago, being introduced to the western world in the 13th century to be used in warfare from the 14th century and in mining from the 17th century.

Black powder was manufactured in Victoria from the 1860s being used in fuzes and as blasting powder for rock breaking. The then rapid growth of Victoria was based on gold, which required blasting powder for its extraction. Black powder was also essential in the construction of railways, roads and water storages.

Black powder has been superseded by modern more effective materials. Today its major use is in fireworks.

Edge runner mills have been used for over 2000 years for grinding, crushing and mixing many varied materials, such as olive oil, mineral ores and pharmaceuticals.

This mill was built in 1942, bringing these ancient technologies into the 20th century. It was sited in Melbourne's west which had been the centre of Australia's explosives and munitions industry since the 1870s.

Following closure and redevelopment of these many manufacturing sites, this Black Powder Mill is the only remaining explosives processing building with its original plant intact and in its original location. It represents a centuries' old process, important in both military and commercial fields and shows the exacting engineering design principles based on hard experience which ensured that these inherently dangerous materials were made safely.

These principles have been incorporated into the design of this building, the plant and the method of operation by countless unnamed plant operators, industrial chemists, engineers, supervisors, government officials and regulators.

It is the result of their collective efforts.

7.5.2 Suggested Illustrations

Photographs similar to the following are proposed, subject to availability.

- 1) Photograph 1. 19th century miners tamping charge of black powder.
- 2) Photograph 2. 19th century cannon firing showing effect of black powder.
- 3) Photograph 3. Black Powder Mill and Process Bay showing smooth taped walls, bitumastic felt flooring and cellulose acetate/canvas windows with external electric lighting.

8. References

- *Report on the Circumstances attending an Explosion which Occurred in the Gunpowder Mill House Z.9.,Fuze Powder Section, Explosives Factory, Albion on 18 May 1944*, prepared by E. C. Todner, Executive Member, Operational Safety Committee.
- National Trust of Australia (Victoria), Classification Report for Black Powder Mill, July 2001,
- Wixted D., *Black Powder Mill, Grassy Point Road, Cairnlea, Conservation Plan*, Prepared for City of Brimbank, Heritage Alliance, September 2003,
- Reports to the Parliament of Victoria
 - Chief Inspector of Mines 1878
 - Inspectors of Explosives 1879 to 1893 inclusive
 - Chief Inspector of Explosives 1894, 1903 and 1927
- Technology in Australia 1788 – 1988, Australian Academy of Technological Sciences and Engineering, Melbourne 1988, page 636,at <http://www.austehc.unimelb.edu.au/tia/636.html>, accessed June 2016.
- Linge, G J R, *Industrial Awakening:A Geography of Australian Manufacturing, 1788-1890*, Australian University Press, Canberra, 1979.
- Mellor, D P, *The role of science and industry*, Australian War Memorial, Canberra, 1958.
- Buchanan, B., (Ed), *Gunpowder: The History of an International Technology*, Bath University Press, 1996.
- Various references as noted in footnotes.

APPENDIX 1 Maps, Plans and Drawings

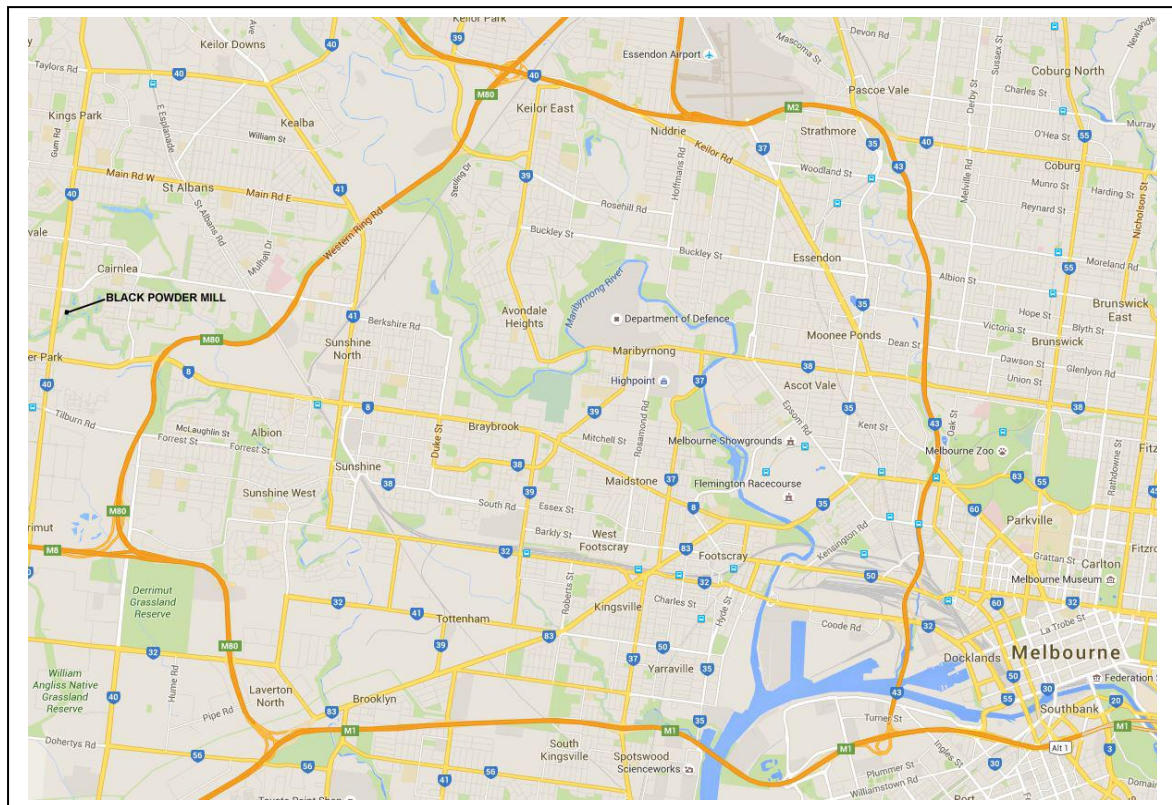


Image 1. Location of Black Powder Mill, Cairnea, Victoria, in relation Melbourne CBD.
Image courtesy Google

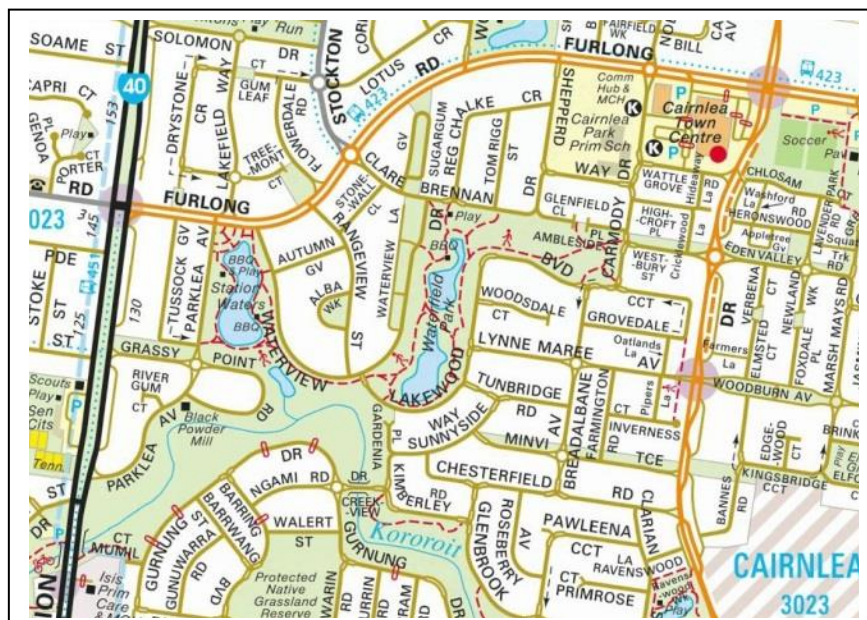


Image 2. Black Powder Mill Cairnea
Image courtesy Melway, Map 25 F6.



Image 3. Black Powder Mill, Cairnlea, Immediate Location
Image Google Earth October 2015

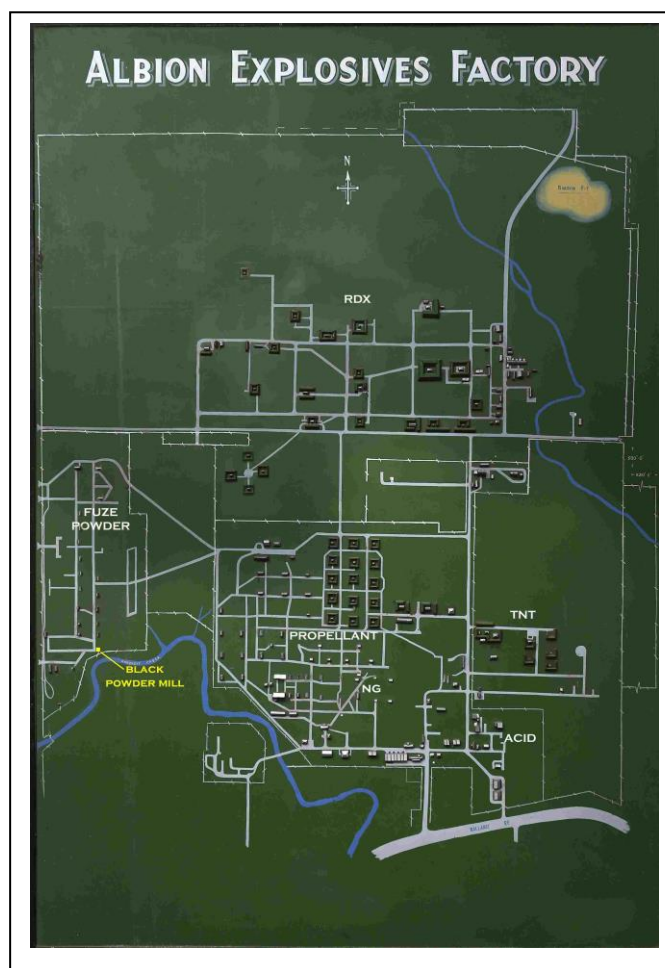


Image 4. Albion Explosives Factory Layout, c1975.
Image courtesy Living Museum of the West



Image 5. Aerial View of Albion Explosives Factory looking east, c1980.
Image courtesy Orica Limited. Identification by Friends of the Black Powder Mill Inc.

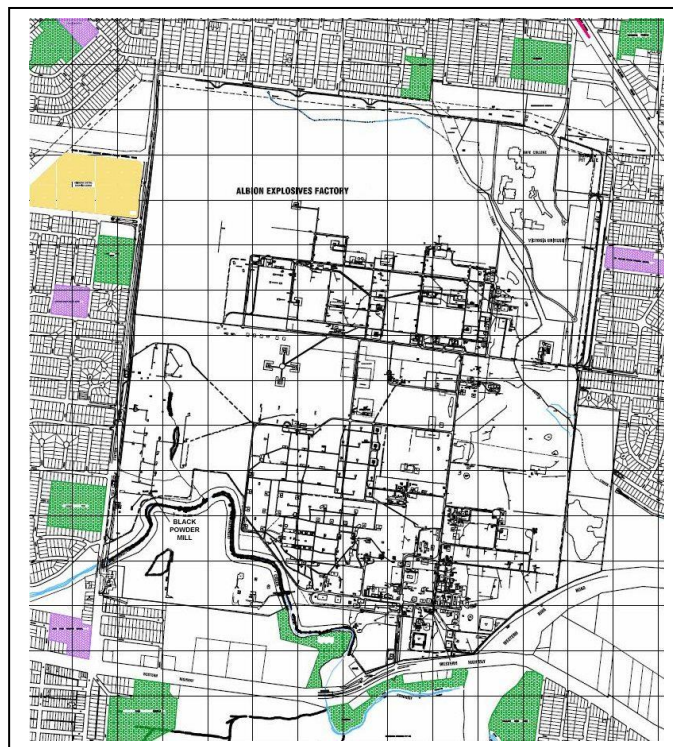


Image 6. Albion Explosives Factory Site, showing surrounding development leading to closure in 1986.
Image courtesy Golders Pty Ltd.

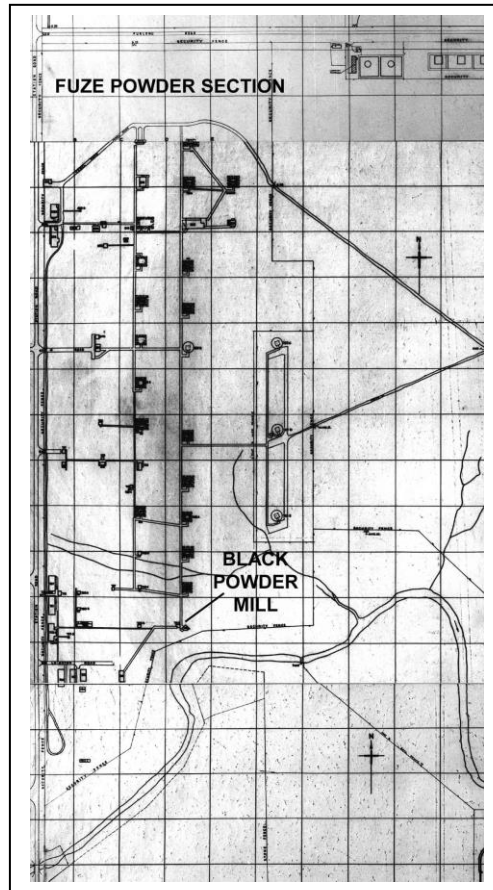


Image 7. Fuze Powder Section, Albion Explosives Factory
Image courtesy Golders Pty Ltd.

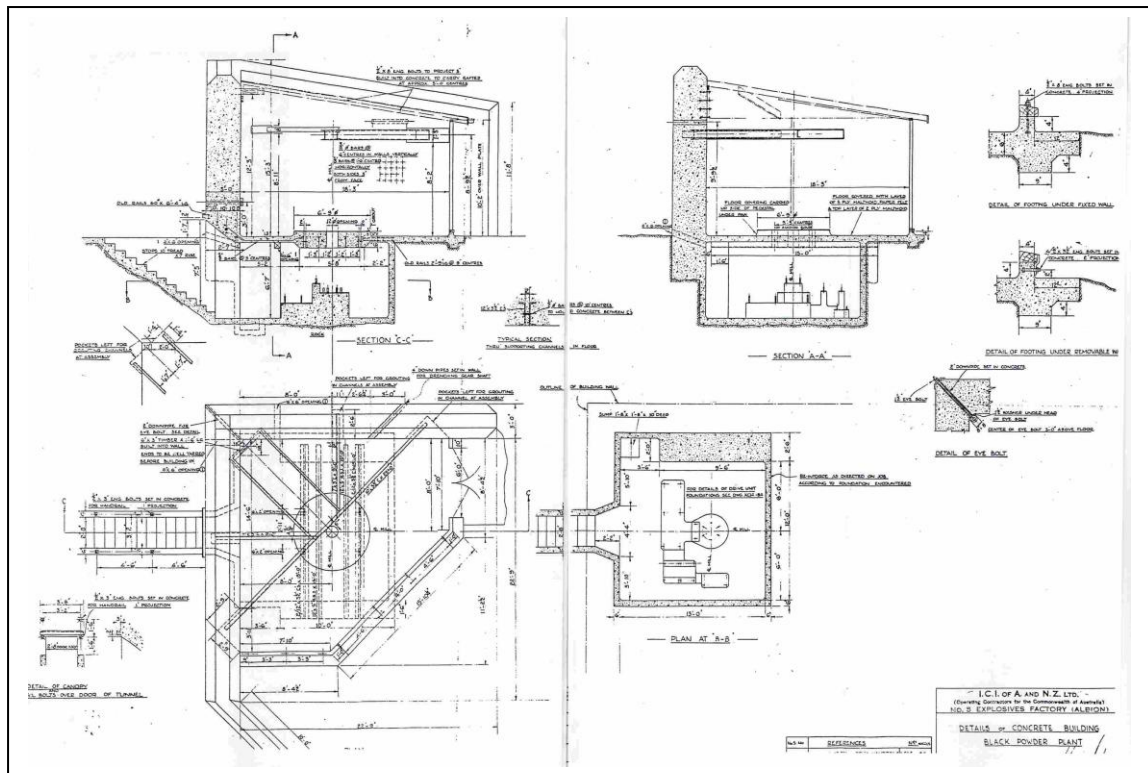


Image 8. Details of Concrete Building, Black Powder Plant, Albion Explosives Factory, Drawing B/22131/P.
Image courtesy Orica Limited.

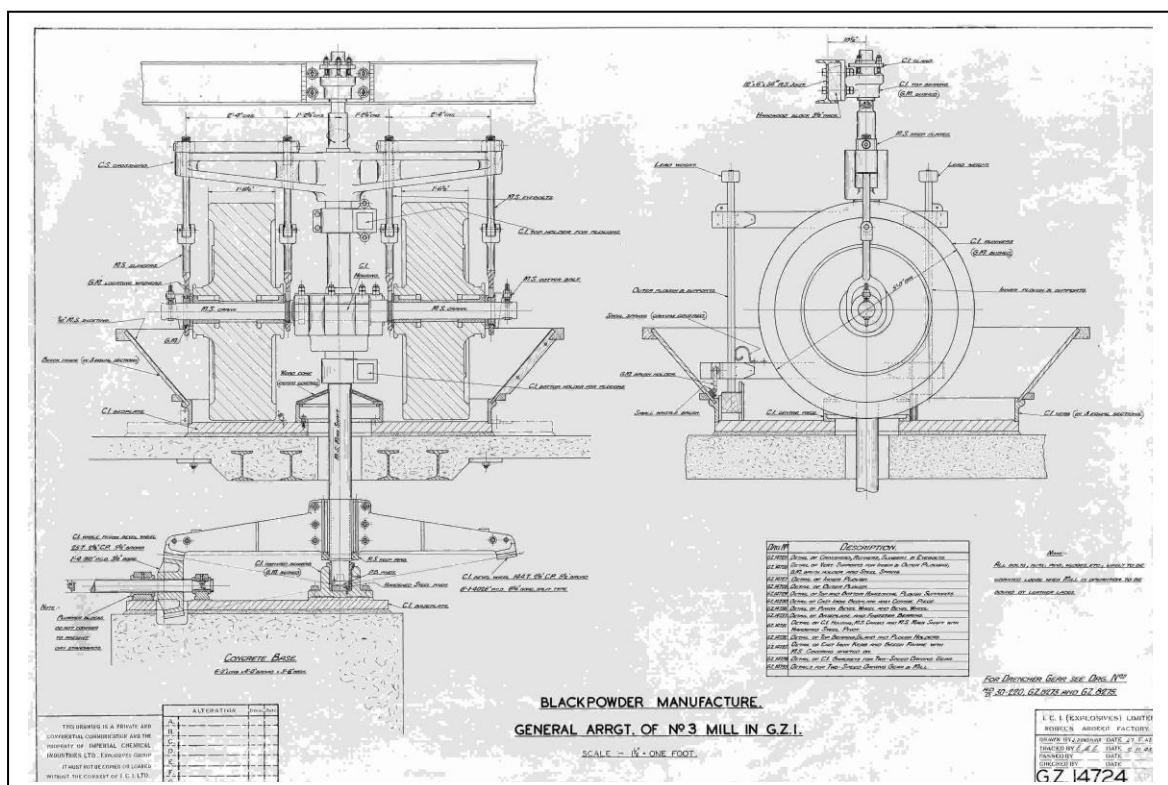


Image 9. General Arrangement of a Black Powder Mill formerly installed at ICI UK Factory at Ardeer, Scotland.

Note: This mill is generally similar to the Black Powder Mill at Albion Explosives Factory, but differs in a number of details. This is particularly so for the bowl which in this case has been fabricated in sections whereas the Albion iron alloy bowl has been cast in one piece.
Image © Courtesy of Historic Environment Scotland (E M Patterson Collection).

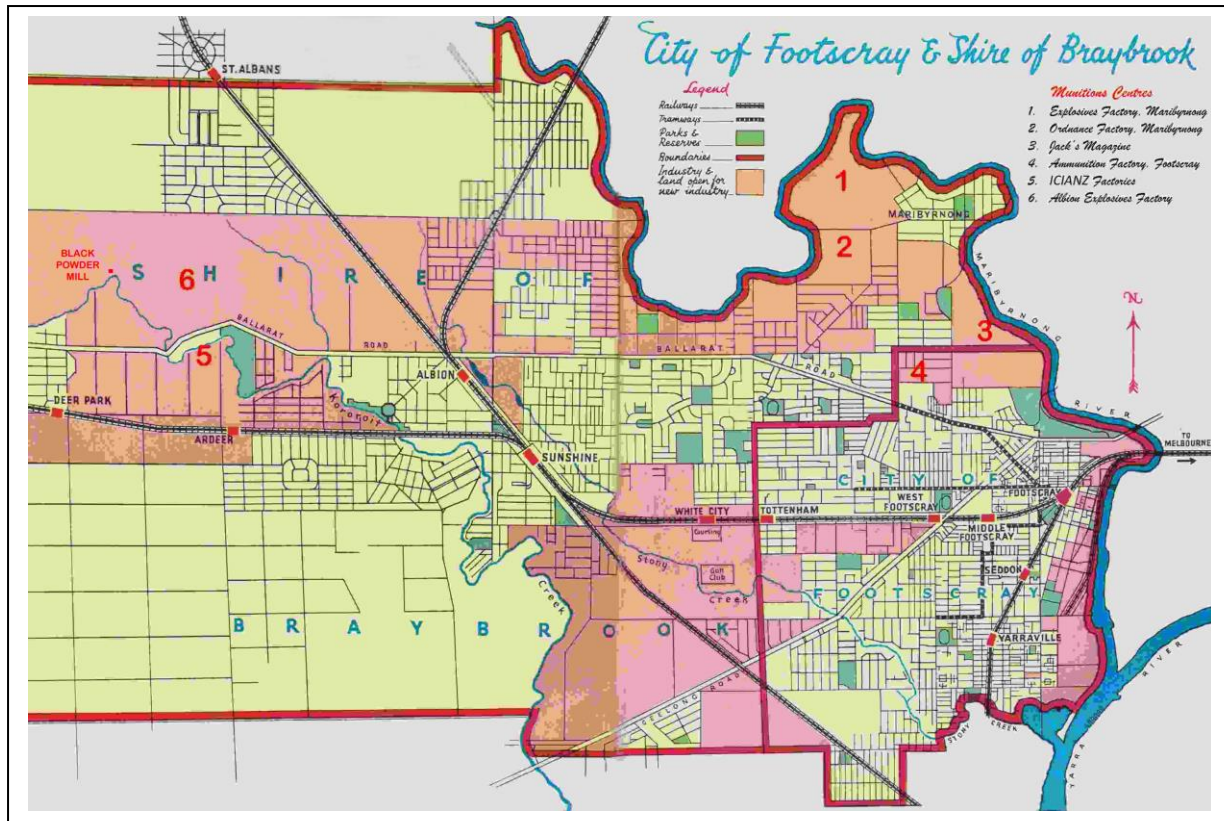


Image 9. "Australia's Arsenal"
Munitions Centres in the City of Footscray and the Shire of Braybrook, 1939 -1945,
*Image Courtesy O Ford, adapted from 'Forging Ahead', City of Footscray
and the Shire of Braybrook, 1947.*

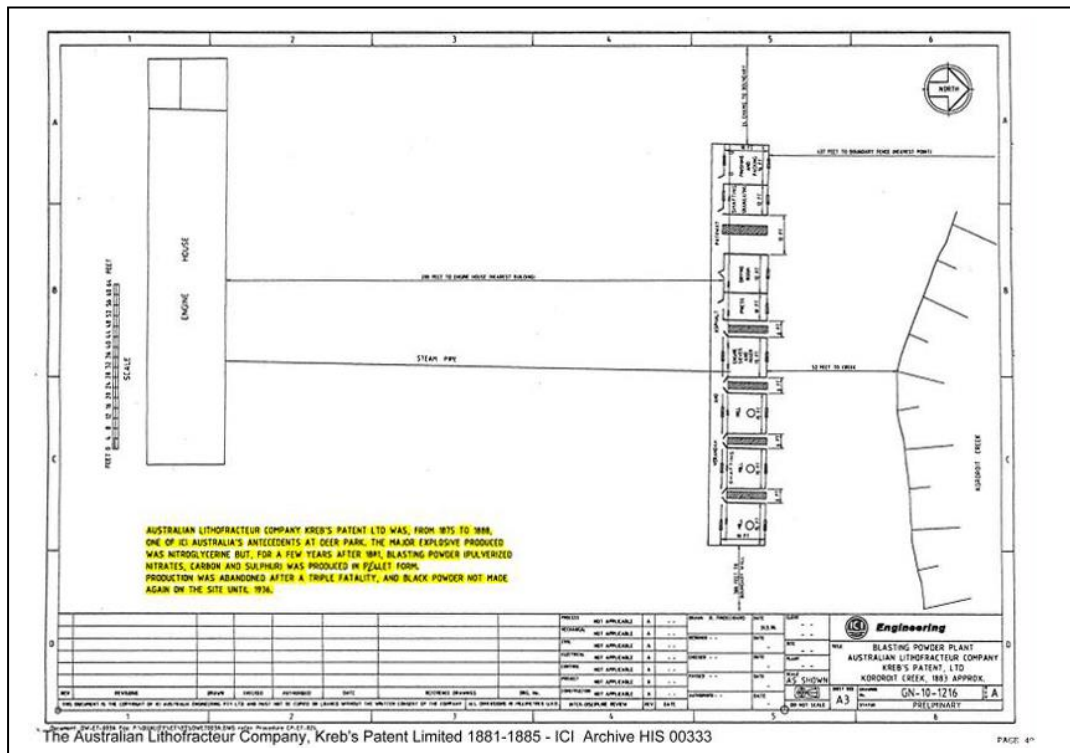


Image 10. Blasting Powder Process Building, c1890
Australian Explosives and Chemical Company Ltd
Image courtesy Orica Limited

APPENDIX 2 Photographs



Photograph 1. Black Powder Mill, Building 745, Fuze Powder Section, c1986.
Photograph courtesy the late Mr David Meale, 2005



Photograph 2. Process Operator wearing Danger Building Clothing
glazing Black Powder, c 1943.
Courtesy Department of Defence



Photograph 3. Heavy Blast Protection Concrete Walls, Black Powder Mill.
Photograph Courtesy the late Mr David Meale, 2005



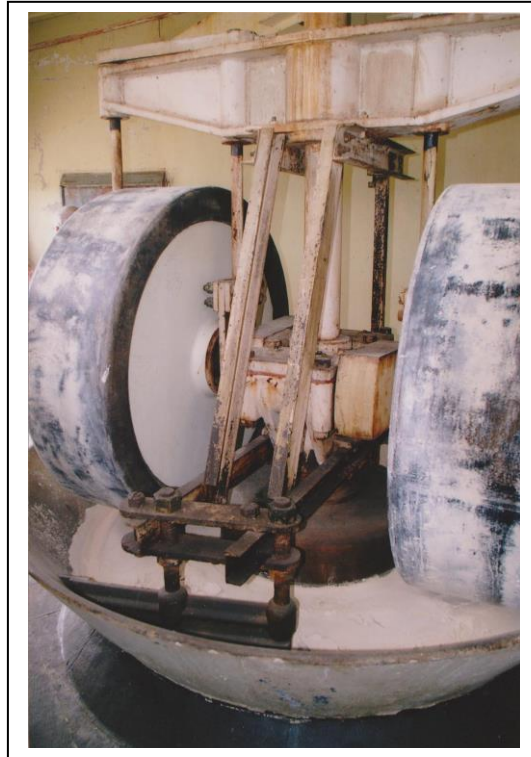
Photograph 4. Edge Runner Mill showing the two 5 tonne Rollers, vertical drive shaft and Roller Suspension arm.

Photograph Courtesy the late Mr David Meale, 2005.



Photograph 5. Black Powder Mill and Process Bay showing smooth taped walls, bitumastic felt flooring and cellulose acetate/canvas windows with external electric lighting.

Photograph Courtesy the late Mr David Meale, 2005.



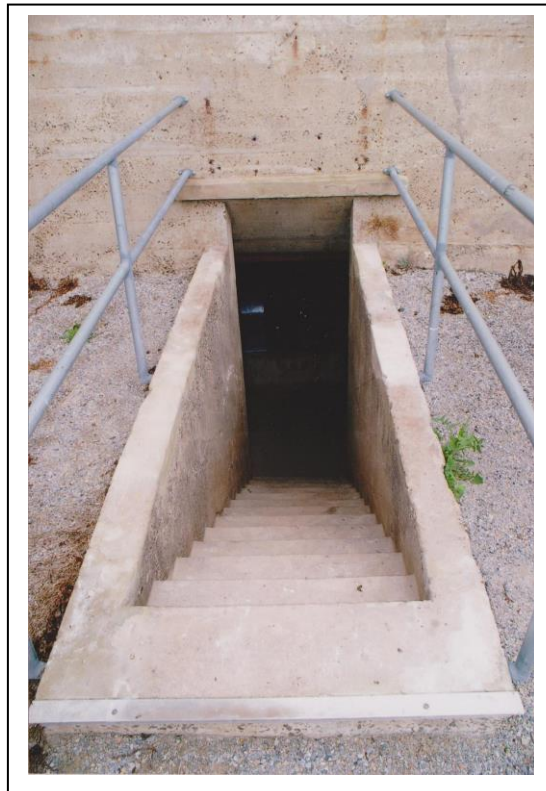
Photograph 6. Mill with rollers and phosphor bronze plough to return material to beneath the Rollers.

Photograph Courtesy the late Mr David Meale, 2005.

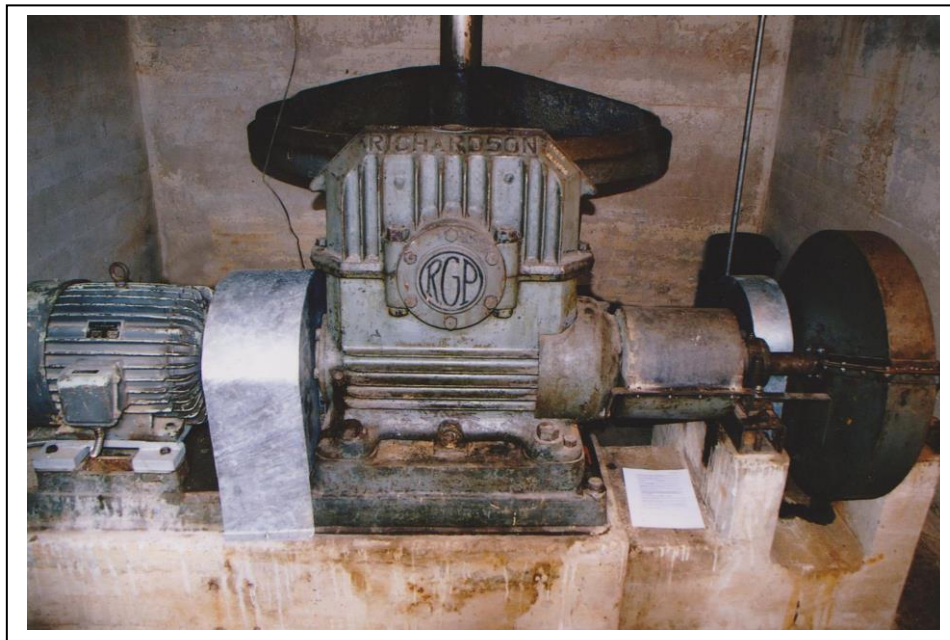


Photograph 7. Drenching Gear showing water container resting on beams with trip mechanism to its left.

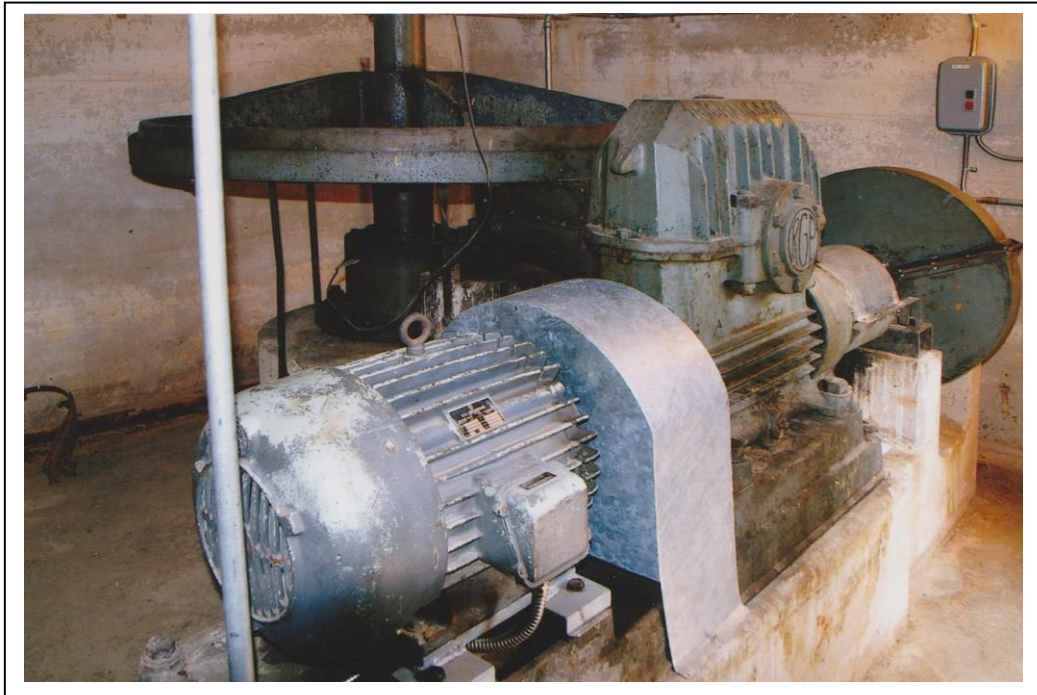
Photograph Courtesy the late Mr David Meale, 2005.



Photograph 8. Stairway access to basement motor room and switch gear.
Photograph Courtesy the late Mr David Meale, 2005.



Photograph 9 Drive train for Mill, showing low speed reduction gear on right,
 high speed motor on left, worm wheel reduction gear box in centre,
 with large crown wheel and pinion behind
Photograph Courtesy the late Mr David Meale, 2005.



Photograph 10 Drive train for Mill showing high speed motor in foreground,
with gear box behind and crown wheel and pinion drive to the left.
Photograph Courtesy the late Mr David Meale, 2005.



Photograph 11 Shadow Board showing permitted wooden and non-ferrous tools.
Photograph Courtesy Friends of the Black Powder Mill Incorporated.

APPENDIX 3 Black Powder

The following information has been taken from the Method Book prepared by ICIANZ Ltd in 1945 for Operators working in the Fuze Powder Section at Albion Explosives Factory. The Method Book has been provided courtesy the Department of Defence.

Introduction

Time ring fuze powders are used in certain fuzes for anti-aircraft and howitzer shells. The quality which renders them useful for these specific requirements is uniformity of burning rate despite variation in pressure and rapid spin of shell.

The ingredients are shown below.



Saltpetre
Potassium Nitrate
 KNO_3
65-75%



Sulphur
S
10-15%



Charcoal
C
15-20%



Black Powder

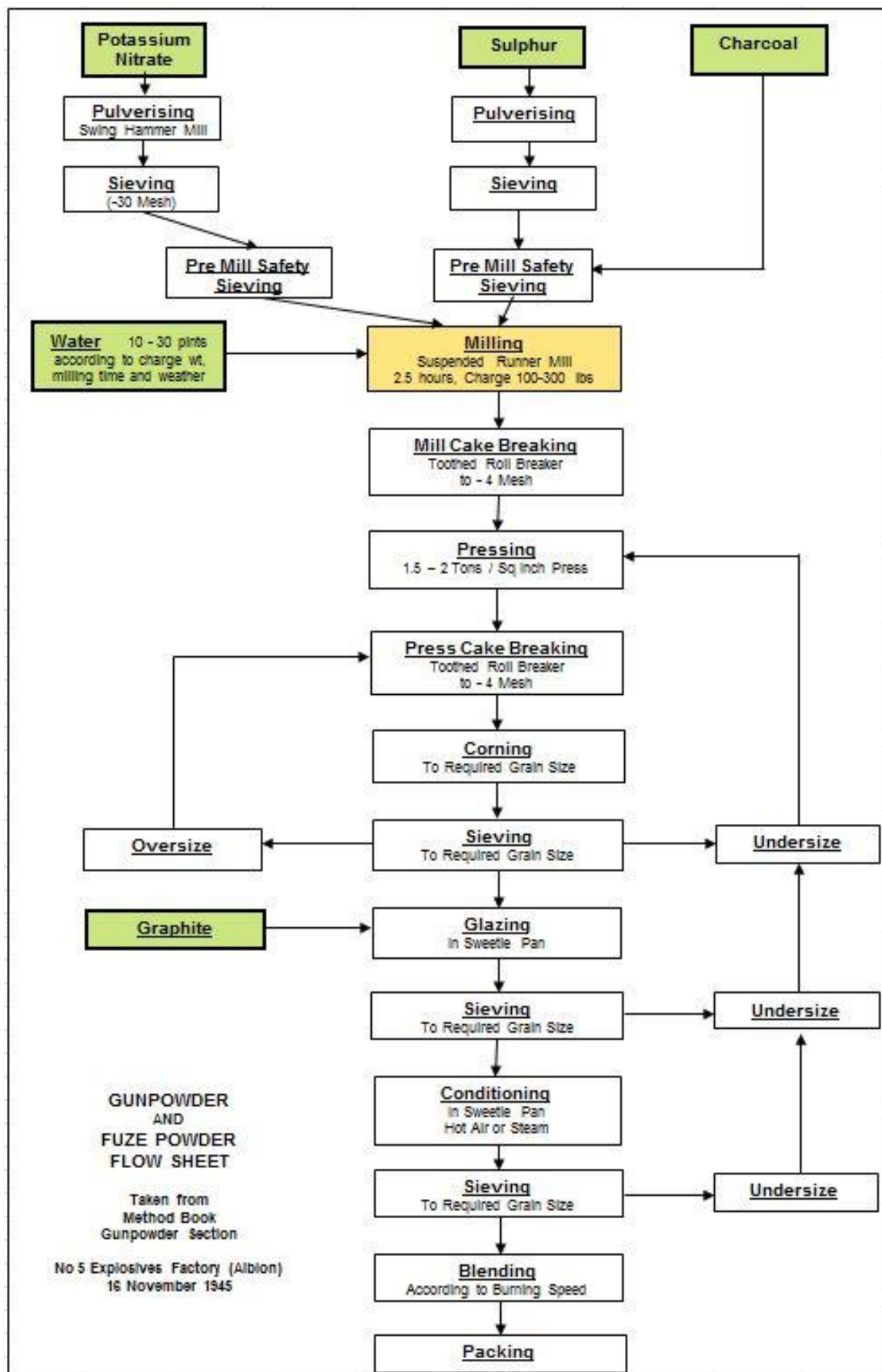
Summary of Process Employed at Albion

Time-ring fuze powder of the gunpowder type is a mechanical mixture of nitre, sulphur and charcoal. Fuze powders vary in burning speed according to the required specification which states the percentage composition of the powder, the type of wood from which the charcoal will be made and the carbon content of the charcoal.

Ingredients for fuze powders are pulverised and sieved, and milled with the addition of water. The mill cake is broken and pressed into cakes, then follows granulating, polishing and conditioning for moisture content.

The approximate burning rate is ascertained and used for making final lots when the burning speed is determined in the specified fuze.

The process is summarised in the following Process Flow Diagram.



The following is a general description of the process.¹

At the Black Powder Section the charcoal is made by burning wood in large retorts in the absence of air. It is burnt in different degrees to give charcoal of varying carbon content. The charcoal is then ground with the sulphur in a ball mill and screened. A hammer mill crushes the potassium nitrate till it is fine.

The three constituents are then combined in the mill house. No person is allowed in the mill house while the mill is working. The wheels of the mill are steel –six tons each. The powder, with water added to bind it, is ground and when ready forms a layer an inch thick over the nine-foot diameter pan.

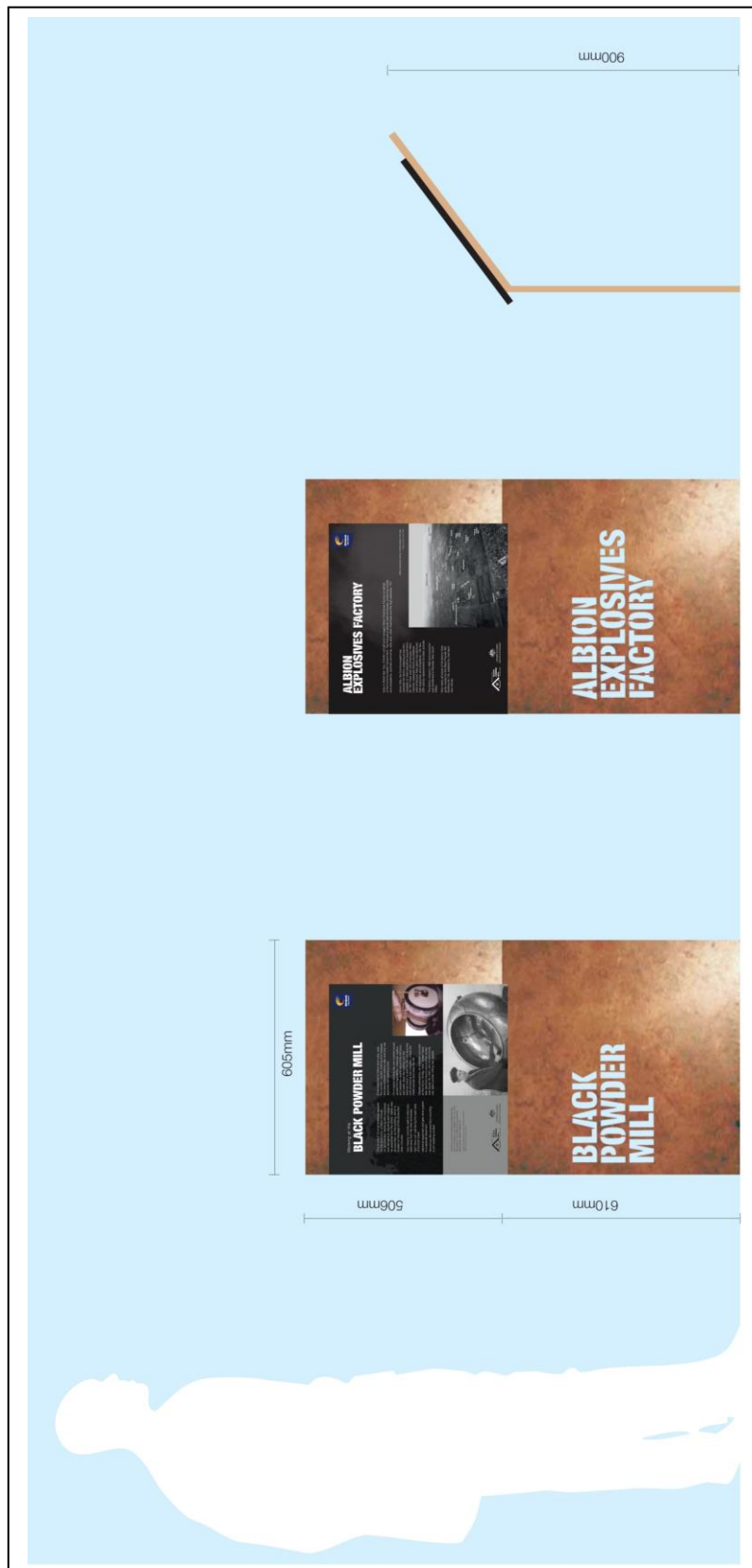
The next operation is pressing to consolidate the milled grains to a uniform density to prevent later separation of the individual components. The milled powder is piled up in layers about two inches thick on aluminium sheets. These are put into a press and the resulting solid sheets are broken into pieces before they go to the screening rooms. Spiked rollers break the sheet up further and the pieces are further reduced in the corning machines. The resulting grains are passed through wire mesh screens - like large rectangular sieves. The required fineness varies with the purpose for which the powder is to be used. The fine grades are the consistency of castor and granulated sugar, while the coarsest is like gravel.

The next stage is glazing where the powder is mixed with graphite and polished until it shines. This protects the powder from damp. After sampling and testing for burning rate the powder is packed and dispatched. The finer the grain size, the faster the powder burns.

¹ From ICIANZ CIRCLE, 12 February 1960, page 4, copy courtesy Orica Limited.

APPENDIX 4

Drawings of Interpretation Panels and Mounting Stand



Notes

1. Base to be of "Corten" steel, weathered and stabilised.
2. Base to be set in concrete.
3. Texts and images to be on anodised aluminium with an anti-graffiti polyurethane clear coating.
4. Information Panel to be mounted on upper inclined face of base.
5. Acknowledgement Panel to be mounted on lower vertical face of base clear of title.
6. Panel to be mounted outside protective fence near entrance to Mill enclosure.
7. The title "ENGINEERING HERITAGE" to be laser cut in the support base as in the existing panels.

1. Information Panel

ENGINEERING HERITAGE

Black powder has several names and uses:

gunpowder when used as a propellant;

fuze powder when used as a delay;

blasting powder when used as an explosive in military, mining and civil engineering applications.

Each is an intimate mixture of saltpetre (potassium nitrate), charcoal and sulphur. It was known to the Chinese over 1000 years ago, being introduced to the western world in the 13th century to be used in warfare from the 14th century and in mining from the 17th century.

Black powder was manufactured in Victoria from the 1860s being used in fuzes and as blasting powder for rock breaking. The then rapid growth of Victoria was based on gold, which required blasting powder for its extraction. Black powder was also essential in the construction of railways, roads and water storages.

Black powder has been superseded by modern more effective materials. Today its major use is in fireworks.

Edge runner mills have been used for over 2000 years for grinding, crushing and mixing many varied materials, such as olive oil, mineral ores and pharmaceuticals.

This mill was built in 1942, bringing these ancient technologies into the 20th century. It was sited in Melbourne's west which had been the centre of Australia's explosives and munitions industry since the 1870s.

Following closure and redevelopment of these many manufacturing sites, this Black Powder Mill is the only remaining explosives processing building with its original plant intact and in its original location. It represents a centuries' old process, important in both military and commercial fields and shows the exacting engineering design principles based on hard experience which ensured that these inherently dangerous materials were made safely.

These principles have been incorporated into the design of this building, the plant and the method of operation by countless unnamed plant operators, industrial chemists, engineers, supervisors, government officials and regulators.

It is the result of their collective efforts.

Insert Engineering Heritage Australia logo.



Images courtesy etc, etc.



Miners tamping a charge



Cannon Firing



Edge Runner Mill used for Black Powder

2. Acknowledgement Panel

Logo of Commonwealth of Australia Department of Defence	Logo of Thales Group	Logo of Orica Limited	Engineering Heritage Marker
--	-------------------------	--------------------------	-----------------------------------

APPENDIX 5 Edge Runner Mills

The edge runner mill is a very old, multi-purpose technology which has been known for over 2000 years. It has been applied to many industries from food processing, to mining, to explosives, to pharmaceuticals and many others. It evolved from the traditional grain mill which consisted of two horizontal stones, one fixed, the bed, and a second moveable one, the runner, rotating above the first but adjustable to provide the correct clearance between the stones. In the edge runner mill the axle of the rotating stone has been moved through 90° so that the stone runs like a wheel. This allows a greater pressure to be applied to the grinding or crushing surfaces as the whole weight of the stone now rests on a much smaller area. The clearance between the runner and the bed can still be adjusted.²

The horizontal axle of the edge runner is usually pivoted about a centre point so that the wheel runs in a circular manner on a bed or trough containing the material to be treated. Two runners can be 'ganged' together, rotating at opposite ends of the horizontal axle. In some cases, four runners may be attached, as in a cross, to the single vertical drive shaft. The runners both roll and slide so that a shearing action is produced while at the same time high pressure is exerted by the mass of the runner on the small contact area.

One of the earliest known edge runner mills was the Roman '*mole olearia*' used to extract olive oil. Many examples of such mills with the runners on wooden axles moving around a stone trough built at ground level exist today in the Mediterranean region from Spain, Italy, Greece, Lebanon Israel and Morocco.³ These mills were driven by human or animal power and the stones were given a clearance to avoid crushing the nut to prevent contamination of the oil.

A similar use has been to crush apples for cider. A horse powered single runner mill is on show at a cider making centre in Jersey.⁴

Edge runner mills have been used to manufacture black powder in UK since the late 18th century.⁵ They replaced mechanical stampers which, after a series of accidents, were banned by legislation in 1772, although the works at Faversham in Kent are thought to have used edge runner mills as early as 1734.⁶ Here they were worked by either water- or horse-power.

One of the most prolific users of edge runner mills was the mining industry. Their extensive use in South American has given rise to them also being known as Chilean Mills.⁷ With heavy stone runners, the high pressure generated was effective in crushing hard rock to release metals such as gold and silver and to break down ores for further processing. A horse-powered replica 'Chilean Mill' using original stone wheels was formerly on display at Sovereign Hill Museum at Ballarat, Victoria. The bed was constructed in the ground while the horse walked around the perimeter. Quartz was placed in the trough and after crushing was

² This summary history has been prepared from a number of sources. One other summary can be found at <http://www.cumbria-industries.org.uk/cumbria-an-industrial-history/crush-mills>.

³ Rojas-Sola, J I & Ramirez-Arrazola, C, *Engineering graphics applied to the study of old methods of olive oil production*, Scientific research and Essays, Vol 6(11) pp 2379-2388, 4 June 2011, available online at www.academicjournals.org/journal/SRE/article-full-text-pdf/F9CD72621958.

⁴ As shown at <http://members.societe-jersiaise.org/sdIIj/cider.html>

⁵ Buchanan, Brenda, *Gunpowder Plots, A Celebration of 400 years of Bonfire Nights*, Allen Lane, London, 2005, page 148.

⁶ Percival, A J, *Faversham Gunpowder Industry*, About Faversham No4, 1967. Page 5.

⁷ See <https://www.caseyresearch.com/resource-dictionary/definition/chilean-mill>

panned or cradled to release the gold.⁸ They continue to be used today often in a continuous mode.

Primary crushers such as motor operated jaw crushers produce the feedstock. The ore is usually manually loaded into the bowl together with a water stream. Screens are fitted to one side of the bowl and the ore is reduced in size such that the resultant slurry flows through the screens. The screens are set above the sole plate of the bowl and the material passing the screens flows over a chute onto a steel plate that is continually irrigated with a small flow of mercury. Particles of gold, liberated by crushing, are recovered by amalgamation with the mercury. At days end, the recovered mercury is distilled to separate the gold and the recovered purified mercury is re-used.⁹

Chilean Mills were used at a number of locations on Australian goldfields. Three mills were in operation from 1870 to 1915 at the site of the Reefer Battery at the Adelong Falls Gold Mills Ruins near Tumut, NSW. This site has been awarded Engineering Heritage Marker in 2013.¹⁰

The Victorian Heritage Database recognises the site of a Chilean Mill at Buckeye Creek, Ravenswood, near Bendigo, Victoria.¹¹ While located in the goldfields area it was not associated with mining. It is thought to have been used to grind the coarse local sands and gravel to produce a fine grade of sand for the mortar required for the construction of the bridge over the creek. It is recognised as a 'rare example of a technical feature once common on the goldfields'. In the discussion it is noted that the first Chilean Mill was erected near Chewton soon after 1854, by Jacob Branche using his South American experience. The Chilean Mill at Buckeye Creek is an interesting intact archaeological site and reflects the activities of the railway construction workers in 1862.

The adaptation of this ancient technology to so many varied industries shows how a practical, relatively simple idea can stand the test of time. It is a pointed example of the innovative skills of many generations of users. Its versatility from a rough and ready crushing machine to a sophisticated piece of equipment for the production of a dangerous sensitive material such as black powder is quite amazing. Once familiar in flour mills, it has now been superseded by larger, less labour intensive machines, but it will continue to find specialist applications as in the fine grinding of pharmaceutical products.¹²

⁸ See www.sovereign.com.au, *Sovereign Hill Education, Mining Technology, Research Notes for Secondary Schools*, page 3 and <http://www.victorianplaces.com.au/node/63865>

⁹ From CIM Magazine, June/July, 2007, page 87ff, available at:-
https://issuu.com/cim-icm_publications/docs/4-jj2007

¹⁰ See <https://www.engineersaustralia.org.au/portal/heritage/search> and
<https://www.engineersaustralia.org.au/portal/heritage/adelong-falls-gold-mill-ruins-reserve-reefer-battery-1870>

¹¹ Victorian Heritage Database, Chilean Mill, Buckeye Bridge, Greater Bendigo City, Heritage Inventory Number H7724-0327, Heritage Overlay Number HO629.

¹² See <http://pharmapproach.com/edge-runner-mills-and-end-runner-mills/>

APPENDIX 6

Acknowledgments

Document prepared by:

Noel Tozer, B Chem E, B Com

4 Walerna Road
Glen Iris, Vic, 3146
Retired

Michael Golding, Assoc Dip Chem Eng, Fell Dip Chem Eng

4 Frances Street
Highett, Vic, 3190
Retired

The Friends of the Black Powder Mill Incorporated have been instrumental in the decision to nominate the Black Powder Mill for Engineering Heritage Recognition. This group was formed at the time when Building 745 was threatened with demolition. A number of concerned residents, in conjunction with the National Trust of Australia (Victoria), convinced the Brimbank City Council to hold a public meeting to express their views where an overwhelming majority supported retention of the Mill in its present location. The Sunshine and District Historical Society Incorporated and the St Albans History Society were both actively involved in presenting the case for retention to the Council. The Council acted, reversing an earlier decision for demolition and since that time, have made it possible for the building to be restored and the mill and the drive machinery to be refurbished and for the past 13 or 14 years have maintained the complex. Grants were received from the Victorian and Commonwealth Governments.

Those concerned must be acknowledged since without their foresight and dedication, there would not be a Black Powder Mill to recognise in this way.

They include:

1. Those involved in the initial campaign and restoration program

The late Jack Sheridan, former Mayor, City of Keilor and founding President, Friends of the Black Powder Mill Incorporated, member of St Albans History Society.

Clare Brennan, former Councillor, City of Sunshine, Vice-President, Friends of the Black Powder Mill Incorporated.

The late Wally O'Brien, former member, Friends of the Black Powder Mill Incorporated.

The late Reg Chalke, former member, Friends of the Black Powder Mill Incorporated.

Tom Rigg, member, Friends of the Black Powder Mill Incorporated.

Jeff O'Donnell, former member, Friends of the Black Powder Mill Incorporated.

Chris Evans, former Councillor, City of Brimbank & journalist.

Marion Martin, former Councillor, City of Brimbank, former Mayor, City of Sunshine.

Margaret Giudice, former Councillor & Mayor, City of Brimbank.

The late Frank Ford, former member, Friends of the Black Powder Mill Incorporated.

Olwen Ford, Secretary, Friends of the Black Powder Mill Incorporated.

Kevin Davis, Treasurer, Friends of the Black Powder Mill Incorporated.

The late Des Johnson, local resident and photographer.

Susan Jennison, former President, Melbourne's Living Museum of the West, President, Keilor Historical Society and member, Friends of the Black Powder Mill Incorporated.

Ron Dorre, President, St Albans History Society and member, Friends of the Black Powder Mill Incorporated.

The late David Meale, formerly of Orica Limited.

Professor Geoffrey Blainey AC.

Professor Ian Rae.

Gary Vines, former Curator & heritage consultant, Melbourne's Living Museum of the West; member, National Trust of Australia (Victoria) Industrial History Committee.

David Maloney, formerly of the National Trust of Australia (Victoria), founding Secretary of Friends of the Black Powder Mill Incorporated.

Rohan Lamb, formerly Chairman, National Trust of Australia (Victoria) Industrial History Committee.

Kerrie Poliness, artist, Melbourne's Living Museum of the West.

Peter Haffenden, former Museum Director, Melbourne's Living Museum of the West.

Roger Holloway, Vice-President Melbourne's Living Museum of the West.

Amanda Opie, formerly of Brimbank City Council.

Kerry Hewson, formerly of Brimbank City Council.

John Boles, former member, Friends of the Black Powder Mill Incorporated.

Anne Best, former member, Friends of the Black Powder Mill Incorporated.

The late Joan Carstairs, St Albans History Society & former member, Friends of the Black Powder Mill Incorporated.

The late Leo Dobes, former member, Friends of the Black Powder Mill Incorporated and St Albans History Society.

Don Webster, Sunshine & District Historical Society & Friends of the Black Powder Mill Incorporated member.

Tony Galea, formerly of the Albion Explosives Factory.

Dean Mighell, Electrical Trades Union.

David Wixted, Heritage Alliance.

Bob Sercombe, former Member for the Division of Maribyrnong.

John Speight, President, Australian Manufacturing Workers Union.

Australian Workers Union.

Heritage Victoria.

Department of Defence Archives, Dandenong.

ADI Limited, Mulwala.

Mulwala Explosives Factory, Australian Munitions.

ADI Limited, Melbourne.

Department of Environment & Heritage.

2. Those involved in supporting and interpreting the mill in more recent times, including past and present members of Friends of the Black Powder Mill Incorporated:

Roger Smart

The late Mary Smith

The late Lorna Campbell

Colin Thorpe

Alan Dash

Peter Somerville OAM

Helen Rzesniowiecki

Denis Rietdyk

Peter Waters

Melchior Bajada

Brian O'Reilly

Julie Saroz

Carol Maddern

John Hadfield, photographer

Meredith Thomas, artist

Khalil Eideh, MLC, Member for Melbourne West

Staff of Brimbank City Council, including
Dean Michael, Arts & Culture Coordinator
Christine McAllister, Manager, Libraries & Learning
Chris Bedford, Maintenance Operations

Great assistance was received from Ms Sheryl Holschier, Library Services, Orica Limited who has searched diligently for copies of drawings and historical documents relating to the Black Powder Mill and the involvement of ICIANZ Limited in explosives manufacture in Deer Park and specifically in the construction and operation of the Albion Explosives Factory.

The authors wish to acknowledge the contribution made by Olwen Ford to this Nomination. Olwen is a historian, author, member of the Sunshine and District Historical Society, heritage advisor and founding and current secretary of the Friends of the Black Powder Mill Incorporated. Her knowledge of the history of the Sunshine/Deer Park area is well known and her ongoing review of this nomination has been invaluable.

SUB/011806

17 February 2016

Mr Noel Tozer
Committee of the Friends of the Black Powder Mill Incorporated
By email: bmtnht@gmail.com



Sunshine Office

Alexandra Avenue
Sunshine, Victoria 3020
T 9249 4000
F 9249 4351
W brimbank.vic.gov.au

Dear Mr Tozer,

Black Powder Mill Engineering Heritage Recognition Program

Thank you for advising Council that the Committee of the Friends of the Black Powder Mill Incorporated (the Committee) is nominating the Black Powder Mill building and its equipment for engineering heritage recognition by Engineers Australia.

The Black Powder Mill is an important heritage asset in the City of Brimbank and Victoria. The site is included in the Heritage Overlay of the Brimbank Planning Scheme as HO6 and is also recognised by Heritage Victoria as a site of State heritage significance as VHR 2029.

The Black Powder Mill provides an important example of Brimbank's munitions history and is of historical significance as the sole remnant of the former Albion Explosives Factory, a key component of Australia's wartime and post-war munitions industry. It is of historical interest for its role in the production of gunpowder for specialised use in fuses for high explosive munitions. The Black Powder Mill is of scientific (technological) importance for its rare ability to demonstrate an important stage in the manufacture of gunpowder. The building's siting, structure, machinery and tool shadow board all help to demonstrate the dangerous nature of the process and the special precautions taken to minimise damage in the case of an accident.

Council supports the Committee's application for engineering heritage recognition and acknowledges its important work to preserve, manage and promote the heritage values of the site.

Council will need to consider the installation of interpretative signage through its regular budget process if the application is successful.

Please contact Council's Principal Strategic Planner, Catherine Hunichen on 9249 4455 or catherineh@brimbank.vic.gov.au to discuss this matter further and inform Council about the outcome of the application.

Yours sincerely,

A handwritten signature in blue ink that reads 'S. Menzies'.

Stuart Menzies
Director City Development

CHANGE CONTROL

VERSION 1 JUNE 2016
VERSION 2 JULY 2016
VERSION 3 10 AUG 2016
VERSION 4 16 AUG 2016

FIRST DRAFT WITHOUT APPENDICES
COLLATED WITH APPENDICES INCLUDED EXCEPT 6
COLLATED WITH APPENDICES INCLUDED
FORMATTING IN TEXT SECTION